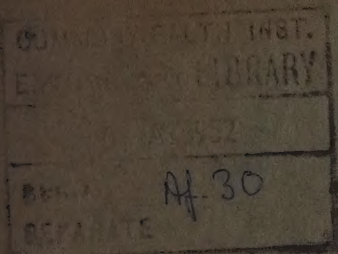


45<sup>e</sup> Année

36<sup>e</sup> Volume



# BULLETIN

DE LA

## SOCIÉTÉ FOUAD I<sup>er</sup> D'ENTOMOLOGIE

anciennement :

*Société Entomologique d'Egypte (1907-1921)*  
et *Société Royale Entomologique d'Egypte (1922-1937)*



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PAR DÉCRET ROYAL EN DATE DU 15 MAI 1923

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1952

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BULLETIN  
DE LA  
SOCIÉTÉ FOUAD I<sup>er</sup> D'ENTOMOLOGIE



QUARANTE-CINQUIÈME ANNÉE

TRENTE-SIXIÈME VOLUME

1952



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# The Tenebrionidae of Southern Africa

## VIII. MATERIALS FOR A MONOGRAPHIC STUDY ON EURYCHORINI

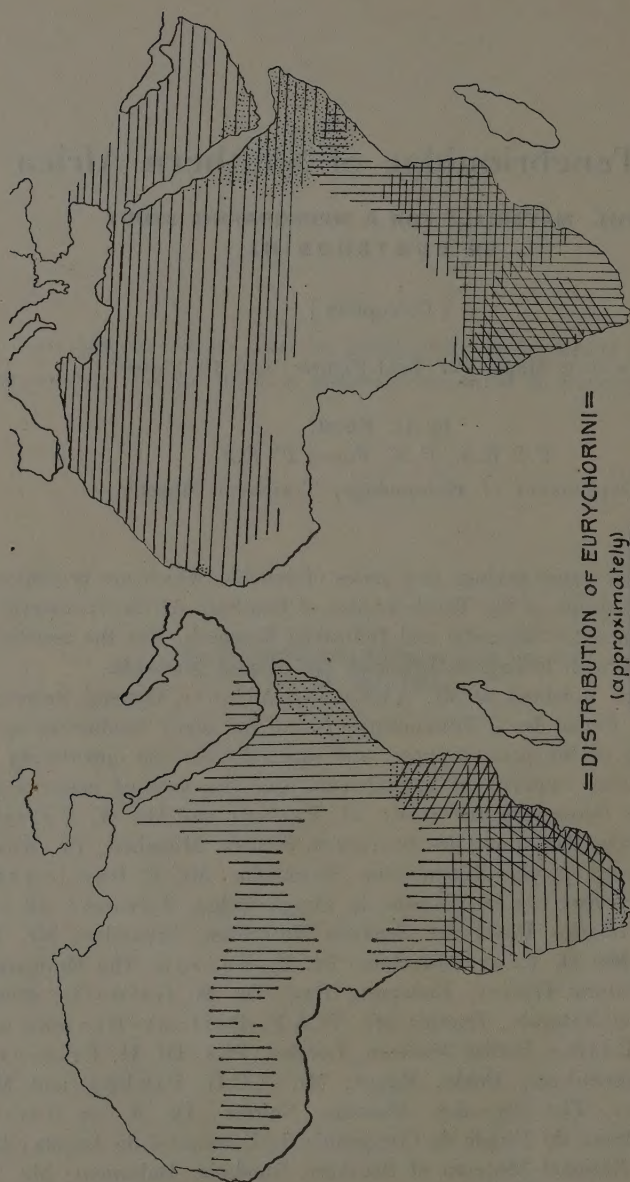
[ Coleoptera ]

(with 2 Maps, 101 Text-Figures, and 13 Plates)

by C. KOCH,  
F.R.E.S., C.M. Fouad I<sup>er</sup> E.S.,  
Department of Entomology, Transvaal Museum

The present paper belongs to a series of articles, which are preliminary notes to a monograph of the Tenebrionidae of Southern Africa, sponsored by the S. A. Council for Scientific and Industrial Research. For the assistance given to me, I wish to express herewith my deepest gratitude.

I am much indebted to Mr. Anastase Alfieri, General Secretary of the Société Fouad I<sup>er</sup> d'Entomologie, Cairo, for many kindnesses as to the publication of the present paper, and especially for the opportunity to examine Egyptian material of Eurychorini. For the loan of material for comparison my thanks are due to Mr. H. Freude and Dr. W. Forster of the Zoologische Sammlung des Bayrischen Staates, München; Dr. René Malaise, Naturhistoriska Riksmuseum, Stockholm; Mr. P. Basilewsky and Dr. H. Schouteden, Musée du Congo Belge, Tervuren; Dr. A. Janssens, Institut Royal des Sciences Naturelles, Bruxelles; Mr. H. Kulzer and Mr. G. Frey, München; Dr. Z. Kaszab, The Hungarian Museum of Natural History, Budapest; Prof. Dr. E. Gridelli, Museo Civico di Storia Naturale, Trieste; Mr. W.A.F. Balfour-Browne and Mrs. Helen Balme, British Museum, London, Prof. Dr. H. Priesner, Ministry of Agriculture, Dokki, Egypt; Mr. E.C.G. Pinhey and Mr. A.F.J. Gedyé, The Coryndon Museum, Nairobi; Dr. A. de Barros Machado, Museu do Dundo da Companhia de Diamantes de Angola; Dr. G. Arnold, National Museum of Southern Rhodesia, Bulawayo; Mr. A. J. Whellan, Entomological Branch of the Department of Agriculture,





Salisbury; Dr. Maria Corinta da Veiga Ferreira, Museu Dr. Alvaro de Castro, Lourenço Marques; Dr. R. Paulian, Institut Scientifique de Madagascar, Tananarive; Prof. Dr. J.C. Faure, Agricultural Research Institute, Pretoria; Dr. Munro, National Collection of Insects, Pretoria; Dr. G. Van Son and Dr. V.F. Fitzsimons, Transvaal Museum, Pretoria; Dr. A.J. Hesse and Dr. H. Andreae, South African Museum, Cape Town; Prof. Dr. J. Omer-Cooper, and Dr. J.C. Van Hille Rhodes University, Grahamstown; Mr. F. Marais, MacGregor Museum, Kimberley; Mr. F. Eberlanz, Stadt-Museum, Lüderitzbucht.

Since the publication of the monograph of Eurychorini by Haag in 1872, many new species were discovered and described, although they could scarcely be distinguished on the basis of the characters introduced by Haag.

It would be a waste of time to refer critically to the literature so far existing on this subject, as practically all the various points of distinction used in the present revision are new ones (for instance: the polygenetic character of the stridulatory organ, the structure of the circum-foraminal parts of prothoracic base, formation of the buccal fissure lobes, development of the elytral epipleurae, etc.).

Therefore the main object was to give a sharp and clear definition of genera and, so far possible, of species, adding to the many unknown and little known forms good illustrations, which never has been done before.

The comparative examination of the trophi and copulatorious organs had to be postponed, as from many monotypical genera and isolated species but single holotypes were available. Neither have I discussed zoogeographical problems (cf. maps, figure A and figure B), as I consider them premature at the preliminary state of my studies.

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The abbreviations used in the present paper refer to the following collections:

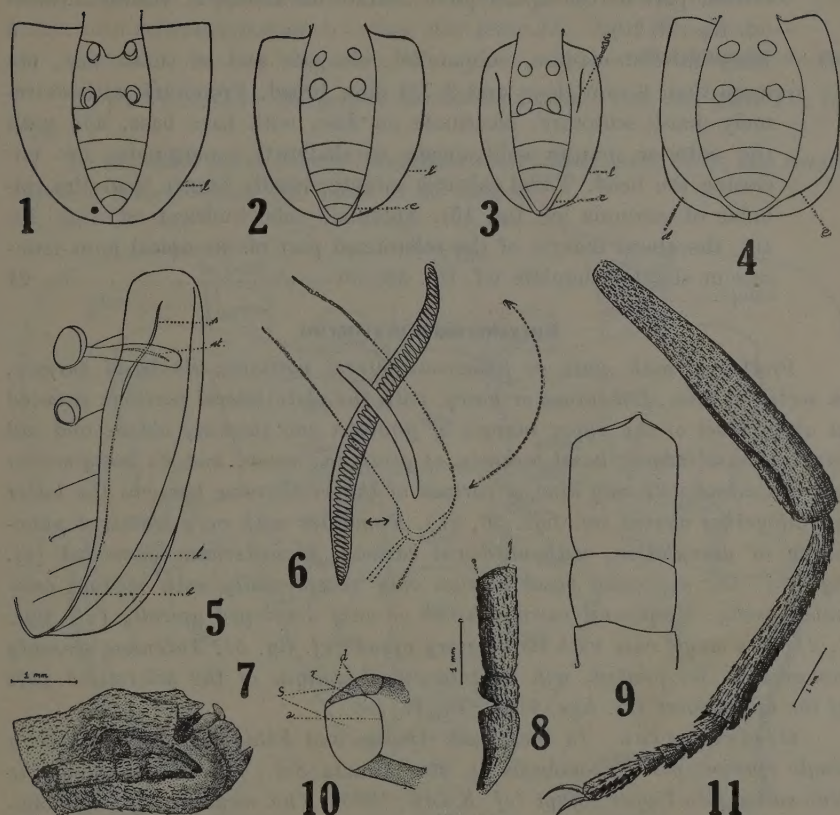
T.M.: Transvaal Museum; S.A.M.: South African Museum; M.C.M.: Musée du Congo Belge; M.D.: Museu do Dundo da Campanhia de Diamantes de Angola; Z.St.S.: Zoologische Sammlung des Bayrischen Staates; C.A.Sc.: Museum of the California Academy of Sciences; C.M.: Coryndon Museum, Nairobi; M.A.C.: Museu Dr. Alvaro de Castro, Lourenço Marques.

#### KEY TO THE GENERA OF EURYCHORINI

- 1 No stridulatory carinae on inner surface of intermediate femora and basal half of the reflected portion of elytra (cf. figs. 1, 2, 3, 12, 20,

- 39, 40, 43, 44; plate I, fig. 68; figs. 94, 96; plate III, figs. 111, 112). ..... 2
- Inner surface of intermediate femora with stridulatory carina; the opposing part of the stridulatory organ on the reflected portion of elytra is formed by the rudimentary basal portion of the epipleural carina, which is transversely ridged like a file (cf. figs. 3, 5, 6; plate I, figs. 66, 67). ..... 9
- 2 (1) Epipleural carina of elytra absent or developed only apically; in the latter case extending forwards from apex of elytra to about level of the penultimate or third abdominal sternite (cf. figs. 1, 2, 12, 20, 39, 43, 44, 94, 96; plate II, fig. 106; plate XIII, figs. 194, 196). ... 3
- Epipleural carina of elytra complete, extending from apex of elytra up to humeral angle, often curved dorsad and forming the lateral outlines of the upper surface of elytra (cf. fig. 4; plate II, fig. 107; plate III, figs. 111, 112). ..... 22
- 3 (2) Basal joint of antennae much shorter than the two following joints taken together (cf. figs. 7, 8, 16-19, 56); the apical margin of the sclerotized basal part of the tenth joint subdentate or angulate (cf. figs. 9, 10, 16, 17), in a single genus (*Falsaspila* n.) truncate (figs. 18, 19). Tibial calcares short; those of posterior tibiae much shorter than the respective claws (cf. figs. 11, 14, 15, 43); anterior tibiae moderately dilated towards apex, with the apical margin not broader than the combined length of the two proximal joints of anterior tarsi. Metasternum short, only half the length of the basal sternite of abdomen (cf. fig. 20). ..... 4
- Basal joint of antennae shaft-like, about as long as the two following joints taken together (cf. fig. 21); the apical margin of the sclerotized basal part of the tenth joint truncate (cf. figs. 22, 23). Tibial calcares long; those of posterior tibiae longer than the respective claws (cf. figs. 24, 25, 87, 88, 89; plate XII, fig. 193; plate XIII, figs. 194-200); anterior tibiae strongly dilated towards apex, with the apical margin as broad as the combined length of the four proximal joints of anterior tarsi (cf. fig. 24), or broader (cf. fig. 121). Metasternum about as long as the basal sternite of abdomen (cf. fig. 12; plate XIII, figs. 194, 196). ..... 29
- 4 (3) Body *Eurychora*-like, broad and of large size, not under 6 mm. long and 3 mm. broad. Pronotum very sparsely sculptured, without discal carinae, with hairy base, and with the anterior margin strongly emarginate and enclosing the head up to genal angles. Tibial calcares distinctly longer than the spinulae of coronula (cf. fig. 14). Antennae strongly compressed (cf. figs. 16, 17); the apical margin of the scler-





Figs. 1-4 = Underside of the posterior portion of the body in the different groups of Eurychorini (schematic): (1) Eurychorini without epipleural carina; (2) Eurychorini with the epipleural carina developed only apically; (3) Eurychorini with stridulatory organ; (4) adelostomoid Eurychorini with complete epipleural carina (*e*: epipleural carina; *l*: lateral edge of elytra; *s*: stridulatory carina). — Figs. 5 and 6: The stridulatory organ in the Eurychorini (schematic): (5) position of the stridulatory organ on the reflected portion of elytra and inner surface of intermediate femur (*e*: epipleural carina; *l*: lateral edge of elytra; *s*: stridulatory carina on elytra; *st*: stridulatory carina on inner surface of femur); (6) the file-like structure of the passive stridulatory carina on reflected portion of elytra, the active stridulatory carina on inner surface of intermediate femur, and the supposed sound-producing movement of the latter. — Fig. 7: *Eurychora* spec., head with proximal portion of antenna in lateral view. — Fig. 8: *Eurychora* spec., the first three antennal joints. — Fig. 9: *Eurychora* spec., apical joint of antennae in lateral view (schematic). — Fig. 10: *Eurychora* spec., apical portion of the apical joint of antennae (*a*: apical margin of the sclerotized basal portion; *d*: subdentate dilatation of the apical margin of sclerotized basal part; *r*: sclerotized ridge, running across surface of sensorial part and uniting the subdentate angles of the median dilatations of apical margin of sclerotized part; *s*: sensorial portion). — Fig. 11: *Eurychora* spec., intermediate leg.



- rotized part of the apical joint dentate at middle of lateral surfaces (cf. figs. 9, 10). ..... 5
- Body *Adelostoma*-like, subparallel, elongate and of small size, not more than 6 mm. long and 2 1/2 mm. broad. Pronotum with extremely dense sculpture, bicarinate on disc, with bare base, and with the anterior margin subtruncate to shallowly emarginate, not enclosing the head. Tibial calcares minute, hardly longer than the spinulae of coronula (cf. fig. 15). Antennae subcylindrical (cf. figs. 18, 19), the apical margin of the sclerotized part of the apical joint truncate or slightly angulate (cf. fig. 56). ..... 21

### Eurychoroid Eurychorini

*Prothorax with alate or foliaceous lateral portions; its basal surface, in sectional view, tomentose or hairy, with the alate lateral portions situated at about level of the upper margin of foramen and showing obtuse and not carinate basal edges; basal foramen of prothorax round and its margination not in contact with any kind of carinae of the prothoracic base, as the latter are altogether absent (cf. figs. 26, 27). Pronotum with very scattered punctation or granulation, without discal carinae. Mesosternum bilevelled (cf. fig. 40); the depressed basal portion only exceptionally with median carinula basally. Epipleural carina absent or only developed apically (cf. figs. 1, 2); in a single case with stridulatory organ (cf. fig. 5). Antennae strongly compressed, ten-jointed, with dentate apical margin of the sclerotized part of the apical joint (cf. figs. 9, 10, 16, 17).*

*Distribution: In the South African and Ethiopian regions, with a single species, viz. Pogonobasis (s. str.) ornata Sol., penetrating along the Nile-valley into Upper Egypt (cf. Koch, 1935). The occurrence of Pogonobasis (Peristepus) bisulcata n. on the island of Madagascar has to be confirmed.*

- 5 (4) Epipleural carina absent (cf. figs. 1, 20). Lateral edge of elytra, examined from the side, either complete and sharply defined, extending from base to apex (cf. figs. 39, 41), or altogether absent (cf. fig. 42). ..... 6
- Epipleural carina developed apically (cf. figs. 2, 43, 44). Lateral edge of elytra, examined from the side, and if at all present, more or less abbreviate apically and not reaching the apex of elytra, which is bordered by the epipleural carina (cf. fig. 44). ..... 11

### Eurychora - group

*Epipleural carina absent.*

*Distribution: Eastern and Southern Africa.*

- 6 (5) Lateral edge of elytra complete (cf. figs. 39, 41). ..... 7

- Sides of elytra without lateral edge, continuously rotundate with the reflected portion (cf. figs. 42; plate IV, fig. 126). ..... *Eurychorula* n. gen. ✓

Type species : *Eurychora acuminata* Fairm., 1891 (cf. plate IV, fig. 126).

To the same genus belong *Eurychora coarctata* Gebien, 1937, and several inedited forms, which still have to be cleared.

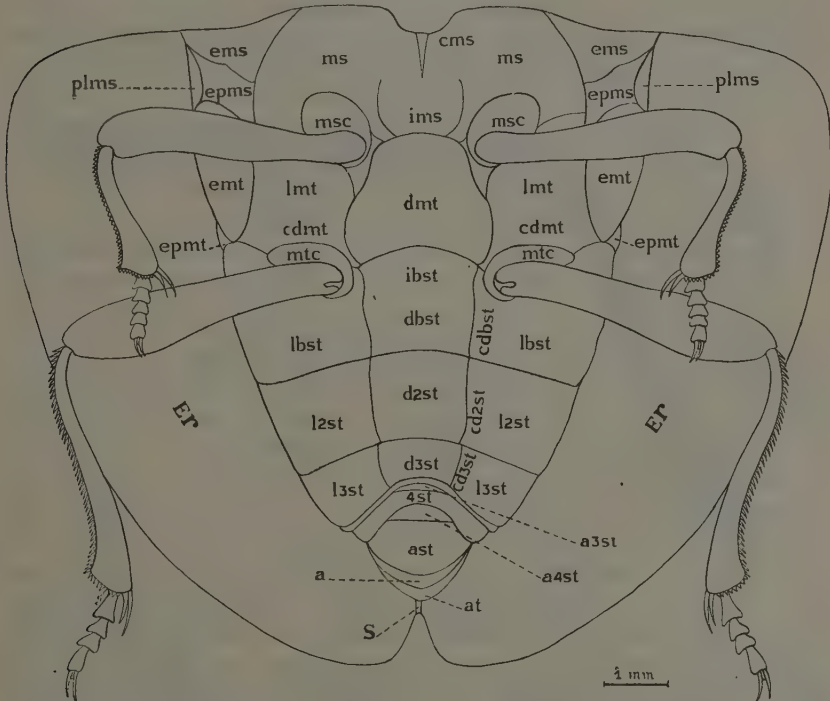


Fig. 12 : *Stips Stali* (Haag), terminology to the different parts of the underside of the posterior portion of body (*ms* : mesosternum; *cms* : median carina on the depressed basal portion of mesosternum; *ims* : intercoxal process of mesosternum; *ems* : episternum of mesosternum; *epms* : epimeron of mesosternum; *plms* : pleurite structure of mesosternum; *msc* : mesocoxa; *dmt* : discal portion of metasternum; *lmt* : lateral portion of metasternum; *cdmt* : carinate delimitation of the discal portion of metasternum; *emt* : episternum of metasternum; *epmt* : epimeron of metasternum; *mtc* : metacoxa; *dbst* : discal portion of basal sternite of abdomen; *ibst* : intercoxal process of basal sternite; *lbst* : lateral portion of basal sternite; *cdbst* : carinate delimitation of the discal portion of basal sternite; *d2st* : discal portion of second sternite; *l2st* : lateral portion of second sternite; *cd2st* : carinate delimitation of the discal portion of second sternite; *d3st* : discal portion of third sternite; *l3st* : lateral portion of third sternite; *cd3st* : carinate delimitation of discal portion of third sternite; *a3st* : apical structure of third sternite; *4st* : fourth sternite; *a4st* : apical structure of fourth sternite; *ast* : anal sternite; *at* : underside of anal tergite; *a* : anal-genital opening; *S* : suture of elytra; *Er* : reflected portion of elytra).



The forms of this genus are very homogeneous and characterized by the absence of the lateral edges of elytra, the strong convexity of the latter, the comparatively small size of body (6 1/2 to 11 mm. long), no apical carina on submentum, short legs, and the very long and dense erect pilosity on the upper surface.

Distribution: From the Tanganyika Territory and the south-eastern part of the Belgian Congo southwards as far as Natal.

- 7 (6) Lateral edge of elytra smooth or obsoletely and irregularly subgranulate (cf. plate IV, figs. 127-131). Supra-antennal surfaces of head strongly raised above level of epistome (cf. fig. 45). Antennae large, much longer than the head is broad (cf. plate IV, figs. 127, 130, 131) ..... 8
- Lateral edge of elytra with regular, very dense, fine and sharp denticulation (cf. plate IV, figs. 122-125). Supra-antennal surfaces of head flattened, almost at level with the epistome (cf. fig. 46). Antennae fine, not or only a little longer than the head is broad (cf. plate IV, figs. 122-125). ..... **Lycanthropa Thoms., 1860**

Type-species: *Eurychora cimicoides* Quens., 1806.

There is no doubt that *Lycanthropa quadrata* Fairm., 1887, described from Mogadiscio in Italian Somaliland and recorded also from Abyssinia (Dirré-Daua) by Lesne, 1922, does not belong to *Lycanthropa*, as the latter is strictly confined to the South African Cape Province.

The species of this genus resemble to some extent the *Serrichora* n., but are broader, more roundish and the open slit between prothorax and elytra is smaller; in the structure of the basal surface of prothorax, they recall somehow *Prunaspila*, as the base of the alate lateral portions, examined in sectional view, is strongly complanate, forming a kind of sharp and denticulate crest, which sometimes almost communicates with the margination of foramen. The interspecific differentiation is well pronounced in the length of the third antennal joint, the inermous or subdentate base of prothorax, etc. One species, viz. *Lycanthropa plana* Haag, is quite peculiar among all the other forms of the *Eurychora*-group by the presence of a short median carinula on the extreme base of the depressed portion of mesosternum.

To *Lycanthropa* <sup>(1)</sup> belong the species *cimicoides* (Quens.); *denticollis* Haag, 1872; *depressa* Haag, 1872; *plicata* Haag, 1872; *plana* Haag, 1872,

(<sup>1</sup>) I do not know the genus *Acanthioides* Fairmaire, 1894, coming from Portuguese East Africa. Fairmaire compares it with *Lycanthropa*, from which it differs, according to the description, in the more convex upper surface of body, which is hardly flattened laterally, the finely granulate sculpture, and in the formation of pronotum. The sides of the latter are strongly rounded and narrowed towards the obtuse posterior angles, the anterior angles are only slightly produced, and the anterior margin is only shallowly emarginate.

with the new subsp. *litoralis*; and the two new species *dimorpha* and *Pienaari*.

Distribution: In the South African region in the Cape Province, presumably confined to the southern portion of the latter.

- 8 (7) Base of pronotum not dentate (cf. fig. 26). Apical margin of buccal fissure lobes straightly truncate (cf. fig. 48). .....

..... **Eurychora Thunbg., 1791**

Type species: *Pimelia ciliata* F., 1781.

To the genus *Eurychora* in its new arrangement belong the following species, which are all strictly confined to Southern Africa: *dilatata* Erichs.,

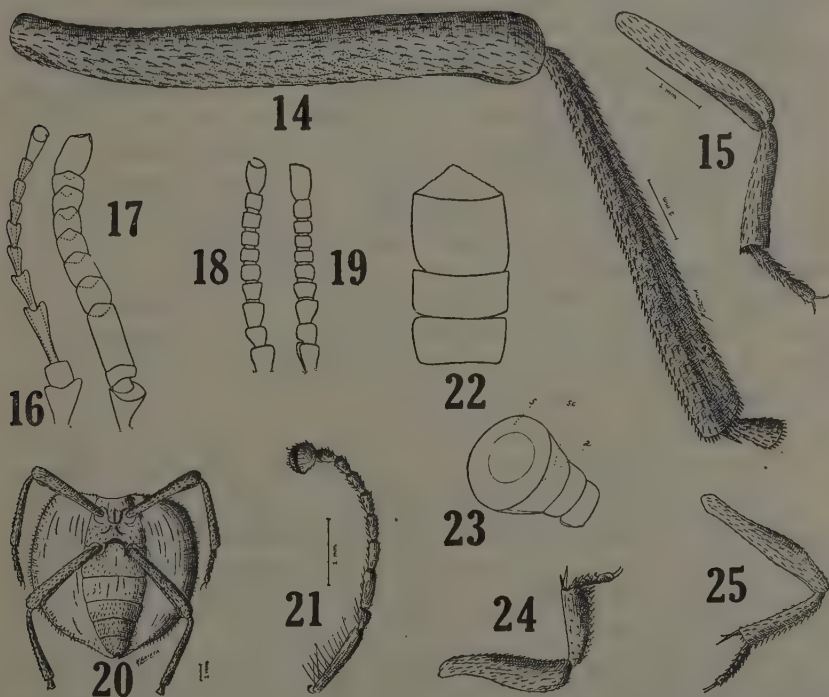


Fig. 14: *Eurychora* spec., posterior leg. — Fig. 15: *Herpsis rugosa* (Cory), posterior leg. — Fig. 16: *Eurychora* spec., the strongly compressed antenna in ventral view (schematic). — Fig. 17: *Eurychora* spec., the strongly compressed antenna in lateral view (schematic). — Fig. 18: *Falsaspila* spec., the subcylindrical antenna in ventral view (schematic). — Fig. 19: *Falsaspila* spec., the subcylindrical antenna in lateral view (schematic). — Fig. 20: *Eurychora* spec., afterbody in ventral view. — Fig. 21: *Lepidochora* spec., antenna. — Fig. 22: *Stips* spec., apical joint of antenna in lateral view (schematic). — Fig. 23: *Stips* spec., apical portion of the apical joint of antennae (s: sensorial portion; sc: sclerotized portion; a: apical margin of the sclerotized portion). — Fig. 24: *Arthrochora arenicola* Geb., anterior leg. — Fig. 25: *Arthrochora arenicola* Geb., intermediate leg.

1843; *Batesi* Haag, 1872; *angolensis* Haag 1872; *terrulenta* Haag, 1872; *suturalis* Haag, 1872; *ciliata* (F.); *major* Solier, 1837; *tumidula* Haag, 1872; *luctuosa* Haag, 1872; *planata* Haag, 1872; *trichoptera* Gerst., 1854; *villosa* Haag, 1872; *barbata* Oliv., 1795; *nitida* Haag, 1872; *convexiuscula* Haag, 1872; *alaticollis* Gebien, 1938; and the new species *Forsteri*, *kaokoveldae*, *reflexa* and *ovamboana*, as well as several inedited forms, which still have to be cleared.

I do not know *Eurychora rotundipennis* Fairm., 1888, from South West Africa; according to the description it seems to be a true *Eurychora*.

All the remaining species, which are listed in the Catalogue of Tenebrionidae by Gebien, 1937, have to be placed to other genera.

Most of the species are well characterized, but the forms of the *barbata*- and *ciliata*-groups appear to be highly problematic as to the development of subspecies, clines and even more subtle geographical or ecological forms.

Haag has tried to separate the *Eurychora* from the allied genera by the elongate third antennal joint; Gebien, 1937, recognizing the fact that any classification, based on this particular, is impossible, proposed to confine the genus *Eurychora* to those species, in which the shoulders are rounded; however a generic division, based on the latter particular, would even create more confusion than that adopted by Haag<sup>(2)</sup>.

Distribution: Widely spread over the whole of Southern Africa (Union of South Africa, South West Africa, Bechuanaland, Portuguese East Africa, southern parts of Angola and Southern Rhodesia). The centre of distribution is the western part of the Cape Province.

- Base of pronotum with a small porrect tooth at each side of middle (similar to fig. 27). Apical margin of the buccal fissure lobes appearing as if slightly triangular and dilated at middle, owing to a shallow emargination in front of the outer lateral angle (similar to fig. 47).

..... ***Steptochora* n. gen.** ✓

Type species: *Eurychora setulosa* Fairm., 1887.

Monotypical genus.

Although I do not know the holotype of *E. setulosa*, described from Zanzibar, I have no doubt to refer to the same species two specimens from British East Africa (Tsavo-Voi, May 1912, leg. H.J.A. Turner; and Bangali Garissa district, May 1943, leg. E. Opiko; both ex coll. Coryndon

(2) Haag, 1875, cit. on page 363: « Die Gattung *Eurychora* ist keine scharf begrenzte und die Unterschiede von den folgenden *Peristepus* und *Pogonobasis* sind nur sehr geringe, so dass es mir zweifelhaft erscheint, ob die drei Gattungen neben einander aufrecht erhalten bleiben können ». Gebien, 1937, cit. on page 27: « Es ist vielleicht das beste, die Gattung *Eurychora* auf die Arten zu beschränken, bei welchen die Schultern ganz fehlen ».



Museum). These two specimens agree furthermore with Gebien's interpretation of *setulosa*, based on specimens from Italian Somaliland (1937).

*Steptochora setulosa* is the single East African species among all the

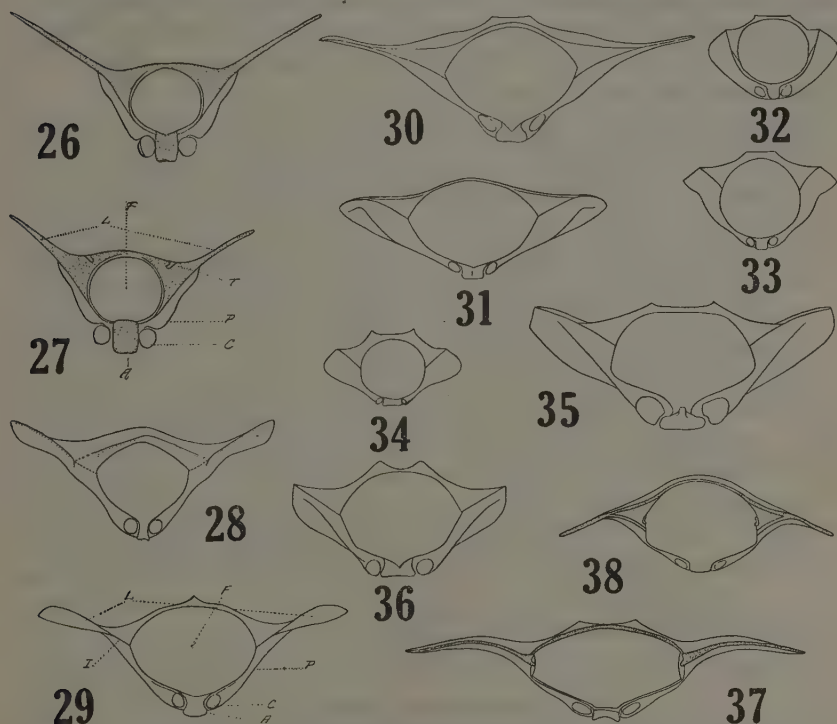


Fig. 26 : *Eurychora* spec., basal surface of prothorax in sectional view (schematic). — Fig. 27 : *Pogonobasis* spec., basal surface of prothorax in sectional view (schematic) (F : basal part of foramen; L : complanate lateral portion of prothorax; T : tooth of pronotal base; P : prosternum; A : intercoxal apophysis of prosternum; C : procoxal cavity). — Fig. 28 : *Prunaspila transvaalensis* n., basal surface of prothorax in sectional view (schematic). — Fig. 29 : *Prunaspila carinicollis* n., basal surface of prothorax in sectional view (schematic) (F : basal part of foramen; L : complanate lateral portion of prothorax; I : inferior carina of lateral portion of prothorax, always in contact with foraminal margination; P : prosternum; A : intercoxal apophysis of prosternum; C : procoxal cavity). — Fig. 30 : *Machlopsis* (s. str.) *crenatocostata* Redtb., basal surface of prothorax in sectional view (schematic). — Fig. 31 : *Platyphanus similis* (Haag), basal surface of prothorax in sectional view (schematic). — Fig. 32 : *Adelostoma granulithorax* Esc., basal surface of prothorax in sectional view (schematic). — Fig. 33 : *Psaryphis nana* Erichs., basal surface of prothorax in sectional view (schematic). — Fig. 34 : *Psaryphulum abbreviatum* (Haag), basal surface of prothorax in sectional view (schematic). — Fig. 35 : *Stipsostoma sculpta* (Geb.), basal surface of prothorax in sectional view (schematic). — Fig. 36 : *Phytolostoma limpopoana* n., basal surface of prothorax in sectional view (schematic). — Fig. 37 : *Stips Stali* (Haag), basal surface of prothorax in sectional view (schematic). — Fig. 38 : *Cimicichora crenulata* n., basal surface of prothorax in sectional view (schematic).

other eurychoroid Eurychorini, which shows the complete lateral edge of elytra and at the same time no epipleural carina around the apex of the latter. In its general appearance it recalls to some extent the broad *Pogonobasis* (*Peristeptus*) *Gestroii* Haag, with which it agrees in the broad, somewhat quadrangular elytra, and the well pronounced obtusangular shoulders.

**Distribution:** In the Ethiopian region in British East Africa and the southern part of Somaliland.

- 9 (1) Prothorax closely jointed to the elytra; the open distance between the lateral portions of pronotal base and humeral portions of elytra absent or very small (cf. plate VIII, figs. 159-161; plate IX, figs. 162-167; plate X, fig. 169). ..... 14
- Prothorax loosely jointed to the elytra; the open distance between the lateral portions of pronotal base and humeral portions of elytra comparatively wide (cf. plate V, fig. 39; plate VII, figs. 153-156; plate VIII, figs. 157-158). ..... 10
- 10 (9) Body of smaller size, 5 to 9 mm. long, not *Eurychora*-like. Elytra densely sculptured, with denticulate or granulate lateral edge (cf. plate VII, figs. 153-156; plate VIII, figs. 157-158); reflected portion densely punctured or granulate. Base of pronotum and elytra bare or ciliate, but without brush-like fringe of hairs (cf. plate VII, figs. 153-156; plate VIII, figs. 157-158). Antennae either subcylindrical (cf. figs. 54, 55, 57-59) or strongly compressed and shaped as in *Eurychora* (similar to figs. 16, 17), but in the latter case the tibial calcares minute, hardly longer than the spinulae of coronula (cf. fig. 53). ... 12

#### **Pogonobasis - group**

*Epipleural carina developed apically. Ethiopian and South African regions.*

- Body broad, of large size, 9 to 15 mm. long, *Eurychora*-like. Elytra smooth and shiny, with only a few fine and scattered punctures, and with smooth lateral edge (cf. plate V, fig. 139); reflected portion almost impunctate. Base of pronotum and elytra furnished with a dense and brush-like fringe of reddish yellow hairs, as in *Eurychora* (cf. plate V, fig. 139). Antennae strongly compressed, shaped as in *Eurychora* (similar to figs. 16, 17). Tibial calcares much longer than the spinulae of coronula (similar to figs. 11, 14). ..... ***Symphochora* n. gen.** <sup>(3)</sup>

<sup>(3)</sup> After having finished the manuscript of the present paper, I received a small series of *Eurychora* *Simoni* Fairm., 1894, collected by Dr. P. Brinck from the Zoological Institute of the Lunds Universitets, in the biggest cave of the Makapan valley (northern Transvaal). The description of the cave, given to me by Dr. Brinck, agrees well with that by Simon,

Type species: *Eurychora humerifera* Gebien, 1937 (cf. plate V, fig. 139).

Monotypical genus.

*Symphochora humerifera* is so far the only species among all other eurychoroid Eurychorini, which is provided with the stridulatory organ of the *Geophanus*-group of the adelostomoid Eurychorini. Systematically it belongs, however, without any doubt to the *Pogonobasis*-group, as it agrees with the latter in all the essential particulars, as there are the identical structure of the basal surface of prothorax, the apically abbreviate lateral edge of elytra, the well developed epipleural carina around apex of elytra, etc. In the truncate apical margin of the buccal fissure lobes it agrees with the genera *Eurychora* and *Serrichora* n., but not with *Pogonobasis*. From *Steptochora* n. it differs, besides the characters mentioned in the key, by the inermous and not dentate pronotal base, the very dense sculpture on the head, the extremely elongate third antennal joint, and the not interrupted transverse impression across middle of pronotum.

Gebien, 1937, did not observe the quite peculiar stridulatory organ of this *Eurychora*-like species. Mr. H. Kolzer, entomologist to the Museum Frey, München, was kind enough to compare one of my specimens with the holotype.

The typical three specimens have been described from the Tanganyika Territory (Ugogo : Dodoma, and Marenga : Makali). The material before

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and as this was the only cave where Dr. Brinck has found any Tenebrionidae at all, I have no doubt that the specimens before me are locotypes.

From an examination of *Simoni* follows that it agrees in all the generic particulars with *Symphochora* from the Tanganyika Territory. It differs, however, strongly from the single species of this genus, *S. humerifera*, as follows :

The elytra, the reflected portions included, show a comparatively dense punctation, their sharp lateral edge is strongly denticulate, bent upwards and only sparsely ciliate (as in many *Serrichora*), the shoulders are almost absent, as the sides of elytra are strongly narrowed towards the base, the latter is only sparsely ciliate. The stridulatory organ is badly defined, as the stridulatory carina on inner surface of intermediate femora is rudimentary, whereas that on reflected portions of elytra is extremely fine. The base of pronotum is sparsely ciliate and does not show the brush-like pilosity as in *humerifera*. The dorsal part of eyes is smaller; the pre-ocular grooves are reduced and only linear (not large and round as in *humerifera*). The extremities are strikingly elongate; the third joint of antennae is abruptly restricted basally, being as long as the three following joints taken together or a little longer, and about five times as long as the second joint (it is very faintly and gradually narrowed towards base in *humerifera*, shorter than the three following joints taken together and only three and a half times as long as the second joint); the basal joint of posterior tarsi is only a little shorter than the remaining tarsus, whereas it is a little longer than the ungual joint and much shorter than the remaining tarsus in *humerifera*. Apart from all these particulars, *Symphochora Simoni* is quite peculiar among all the other eurychoroid Eurychorini by the diaphanous reddish brown colour, due to a considerable reduction of the pigment.

*Symphochora Simoni* is the first true cavernicolous South African Tenebrionid known to me, and clearly defined as such by the loss of pigment, the prolongation of extremities, the reduction of the ocular surface, and the complete absence of shoulders.



me comes from the same territory : Mpangwe (1 spec., Z.St.S.); Bihawana (1 spec., Z.St.S.); Olgasalic, April 1945, leg. Meneghetti (3 spec., C.M.; 1 spec., T.M.); same locality, August 1944, leg. Leahey (1 spec., C.M.); Kibwezi, November 1936, leg. MacArthur (1 spec., C.M.); Kongwa, March 1949, leg. W.A. Young (1 spec., C.M.); Dodama, 1948, leg. H.L. Andrews (1 spec., ex B.M., classified as *Eurychora setulosa*).

- 11 (5) Apical margin of the buccal fissure lobes obliquely truncate as in *Eurychora*, *Lycanthropa*, *Eurychorula* and *Symphochora* (cf. fig. 48); its contours run in a straight line from the inner angle to the outer

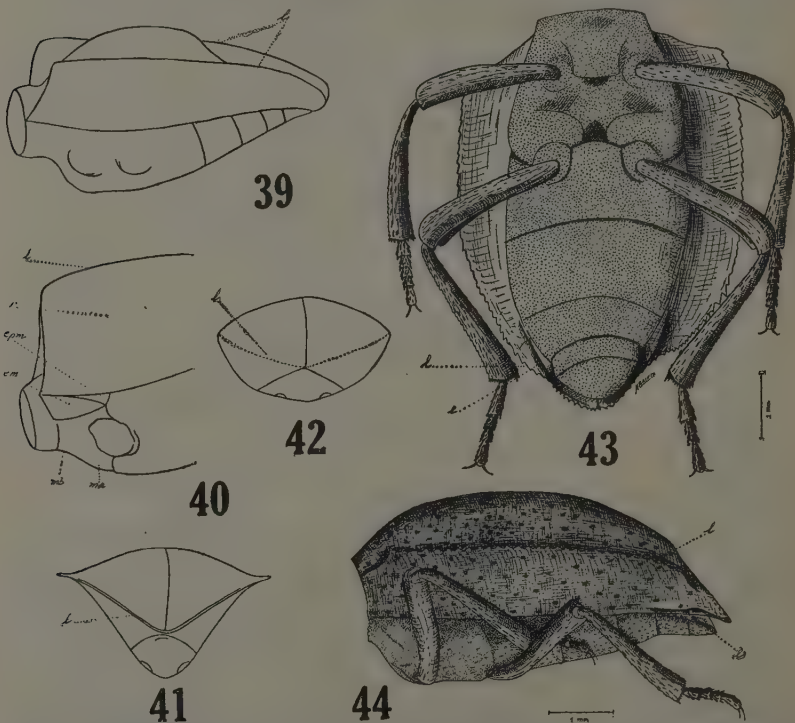


Fig. 39 : *Eurychora* spec., afterbody in lateral view (schematic) (l : lateral edge of elytra). — Fig. 40 : *Eurychora* spec., anterior portion of afterbody in latero-ventral view (schematic) (l : lateral edge of elytra; r : reflected portion of elytra; mb : depressed basal portion of mesosternum; ma : apical portion of mesosternum; em : episternum of mesosternum; epm : epimeron of mesosternum). — Fig. 41 : *Eurychora* spec., afterbody in caudal view (schematic) (l : lateral edge of elytra complete). — Fig. 42 : *Eurychorula* spec., afterbody in caudal view (schematic) (l : lateral edge of elytra scarcely indicated, practically absent). — Fig. 43 : *Serrichora* spec., afterbody in ventral view (e : epipleural carina; l : lateral edge of elytra). — Fig. 44 : *Serrichora* spec., afterbody in lateral view (e : epipleural carina; l : lateral edge of elytra).

one, meeting the infra-epistomal lateral ridge in a right angle. Lateral edge of elytra either very sharp and demarcated by a horizontally flattened submarginal area (cf. plate V, figs. 134, 135, 136, 138), or obsolete (cf. plate V, figs. 132, 133); in the latter case the depressed part of mesosternum with a fine and complete median carinula. .... *Serrichora* n. gen. ✓

Type species: *Eurychora crenata* Sol., 1837.

The new genus comprises the following species, which hitherto have been considered as *Eurychora*: *crenata* Sol.; *murina* Haag, 1872; *Fahraei* Haag, 1872, with the new subsp. *Corintae* and *Lilieri*; *similis* Haag, 1872, and *punctipennis* Haag, 1872, with the new subsp. *Simoesi*. In the present paper, furthermore, there have been described the new species *pogonobasoides*, *Bossmanni*, *karrooensis*, *longantennata* and *Langi*; several inedited forms of the *Fahraei*-relationship have still to be cleared.

The species of this genus can be well divided into two groups.

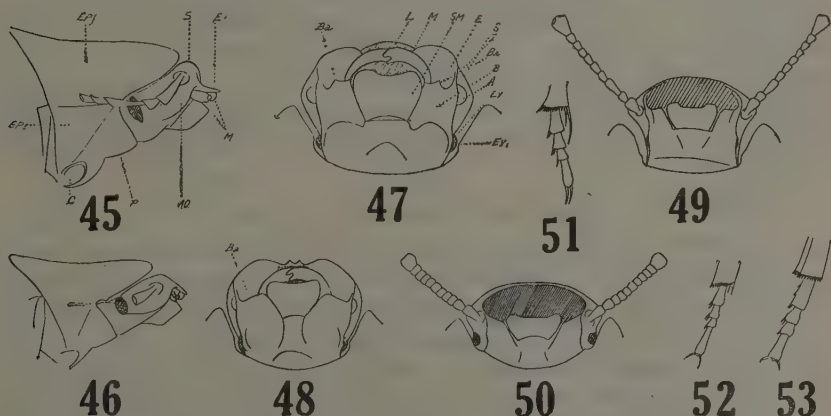


Fig. 45: *Eurychora* spec., head and prothorax in lateral aspect (schematic) (EPf: foliaceous lateral portion of episternum of prosternum; EPi: sloping inner lateral portion of episternum of prosternum; P: prosternum; C: procoxal cavity; S: supra-antennal portion; E: epistome; M: mandibles; AO: antennal-ocular cavity). — Fig. 46: *Lycanthropa* spec., head and prothorax in lateral view (schematic). — Fig. 47: *Pogonobasis* spec., underside of head (schematic) (L: labrum; M: mandible; E: lateral portion of epistome; SM: submentum; S: supra-antennal portion; A: antennal insertion; B: Buccal fissure lobe; Ba: apical margin of buccal fissure lobe; I: infra-epistomal lateral ridge; EY: ventral part of eyes; EYi: infra-orbital structure). — Fig. 48: *Serrichora* spec., underside of head (schematic) (Ba: apical margin of buccal fissure lobe). — Fig. 49: *Pogonocanta longipilis* (Fairm.), underside of head with antennae (schematic). — Fig. 50: *Cimiciopsis Castleae* n., underside of head with antennae (schematic). — Fig. 51: *Cimiciopsis Castleae* n., apex of posterior tibia with coronula and calcares, and posterior tarsus (schematic). — Fig. 52: *Pogonocanta longipilis* (Fairm.), apex of posterior tibia with coronula and calcares, and posterior tarsus (schematic). — Fig. 53: *Prunaspila bicostata* (Fabr.), apex of posterior tibia, with coronula and calcares, and posterior tarsus (schematic).

(1) The *punctipennis*-group, with the two species *punctipennis* and *pogonobasoides*. It is characterized by the inermous and not dentate base of prothorax (bidentate in all the other *Serrichora*), and the peculiar structure of the lateral edge of elytra. The latter, if at all present, is either well pronounced and smooth (*punctipennis*) or obsolete and indicated by a row of more or less subdentate granules, as in several species of the true *Pogonobasis* (*pogonobasoides*). In all the other *Serrichora* the lateral edge of elytra is sharp and either regularly and strongly denticulate, or smooth and sharply separated from the discal convexity of elytra by a horizontally depressed submarginal area (*S. Langi*).

The basal portion of mesosternum with a finè and complete median carinula.

(2) The *crenata*-group, with all the other species.

In two species, viz. *murina* and *Fahraei*, a very abbreviate median carinula is indicated on the extreme base of mesosternum.

Distribution: In Southern Africa, confined to the South-Eastern Cape Province, Natal, Zululand, Swaziland, Transvaal, Portuguese East Africa, Southern Rhodesia, Bechuanaland, Ovamboland, Damaraland, and the southern parts of Angola; absent from the Western Cape Province, the two Namaqualands, Bushmanland and the southern Kalahari.

The distribution of the new genus is nearly vicariant with that of *Pogonobasis* s. lat.

- Apical margin of the buccal fissure lobes appearing as if subtriangular or sometimes subdentate at middle (cf. fig. 47); its contours run in a straight line from the inner angle to middle, where they form a more or less pronounced, often acute angle, which is separated from the outer angle by a distinct emargination or sinuosity in front of the infra-epistomal lateral ridge, caused by the higher level at which the latter is situated. Lateral edge of elytra from sharply defined through all phases of transitional structures to altogether absent (cf. plate V, fig. 137; plate VI, figs. 140-148; plate VII, figs. 149-152). The basal portion of mesosternum only in a single species (*pauperatus*) with a median carinula, but in this case the lateral edge of elytra well pronounced by a row of subdentate granules. .... **Pogonobasis Sol., 1937**

Type species: *Pogonobasis ornata* Sol., 1837.

It is quite impossible to consider *Peristeptus* Haag, 1872, an independent genus, as the single particular, on which Haag has founded his genus, viz., the development of the lateral edge of elytra, varies inter-specifically to such an extent that no sharp separation is possible between *Pogonobasis* and *Peristeptus* (cf. Haag, 1875, pages 24 to 26, and Gebien, 1937, pages 34 and 35). Even a subgeneric division would be justified only by the



need to facilitate the classification of the many and rather difficult forms of this group; I prefer therefore to consider *Peristeptus* a simple synonym of *Pogonobasis*. The lateral edge of elytra can be sharply pronounced, as in most of the *Serrichora*, being either sharply and regularly denticulate, or forming a smooth carina; it can be completely absent; or it is rudimentary (indicated by an obsolete row of subdentate granules) or incomplete (developed only along the basal half of the sides of elytra).

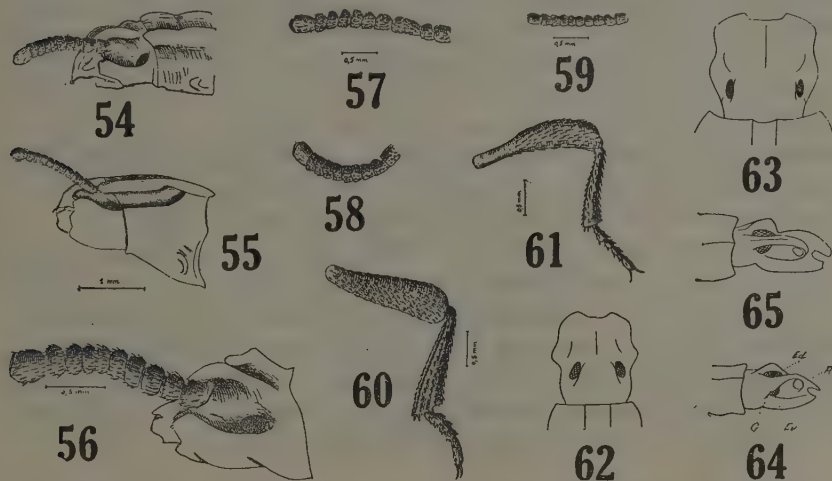


Fig. 54 : *Psaryphis nana* Erichs., anterior body in latero-ventral aspect. — Fig. 55 : *Platyphanus similis* (Haag), anterior body in latero-ventral aspect. — Fig. 56 : *Herpsis rugosa* (Gory), head with antenna in latero-ventral aspect. — Fig. 57 : *Acestophanus elongatus* (Haag), antenna. — Fig. 58 : *Platysemodes benguelensis* (Haag), antenna. — Fig. 59 : *Geophanus pygmaeus* (Erichs.), antenna. — Fig. 60 : *Acestophanus elongatus* (Haag), posterior leg. — Fig. 61 : *Geophanus sepulchralis* Haag, posterior leg. — Fig. 62 : *Herpsis rugosa* (Gory), head in dorsal view (schematic). — Fig. 63 : *Falsaspila Batesi* (Haag), head in dorsal view (schematic). — Fig. 64 : *Herpsis rugosa* (Gory), head in lateral view (schematic) (G : genal canthus; Ed : dorsal portion of eye; Ev : ventral portion of eye; A : antennal insertion). — Fig. 65 : *Falsaspila Batesi* (Haag), head in lateral view (schematic).

Lesne, 1922, and Gebien, 1937, have attributed to the *Peristeptus* a dentate base of prothorax. A careful examination of most of the species, however, has shown that this particular too is not constant. There exist all possible transitional structures from large porrect teeth, visible even in dorsal view of pronotum, to other extreme species, in which the base of prothorax is altogether inermous. It seems, however, that the degree in the development of the prothoracic teeth is constant within the different species.

The basal portion of mesosternum is not carinate along mid-line, except for *P. pauperatus*. Also the upper surface of head is not carinate along

mid-line, except for *P. hirsuta*, where a strong median carina can be observed on the anterior half of head, as it is the case in many *Serrichora*.

The following species belong to *Pogonobasis* in its new conception : *Pog. ornata* Sol. ; *Pog. rugulosa* Guér., 1829-1839 ; *Pog. verrucosa* Er., 1843 ; *Pog. laevigata* Gerst., 1854 ; *Pog. cribrata* Gerst., 1854 ; *Eurych. ovata* Fahr., 1870 ; *Eurych. platessa* Gerst., 1871 ; *Perist. Gestroi* Haag, 1872 ; *Pog. Ruffrayi* Haag, 1872 ; *Perist. Haagi* Harold, 1878 ; *Perist. scutellaris* Haag, 1878 ; *Perist. perforatus* Fairm., 1887 ; *Pog. hirsuta* Péring., 1892 ; *Perist. marginalis* Geb., 1910 ; *Pog. costata* Geb., 1910 ; *Pog. seriepilosa* Geb., 1910 ; *Eurych. pauperata* Lesne, 1922 ; *Perist. conformis* Lesne 1922 ; *Perist. Alluaudi* Lesne, 1922 ; *Pog. cognata* Lesne, 1922 ; *Pog. rhodesiana* Hesse, 1935 ; *Pog. bechuana* Hesse, 1935 ; *Pog. similis* Hesse, 1935 ; *Perist. trilobatus* Geb., 1937 ; *Perist. Gridellii* Geb., 1937, with the ssp. *aterrimus* Geb., 1937 ; *Pog. magna* Geb., 1937 ; *Perist. boranus* Grid., 1939 ; and furthermore the many new forms described in the present paper <sup>(4)</sup>.

The identity of *Pog. Schusteri* Théry, 1932, with *pauperata* (Lesne, 1922) has been correctly established by Gebien, 1937.

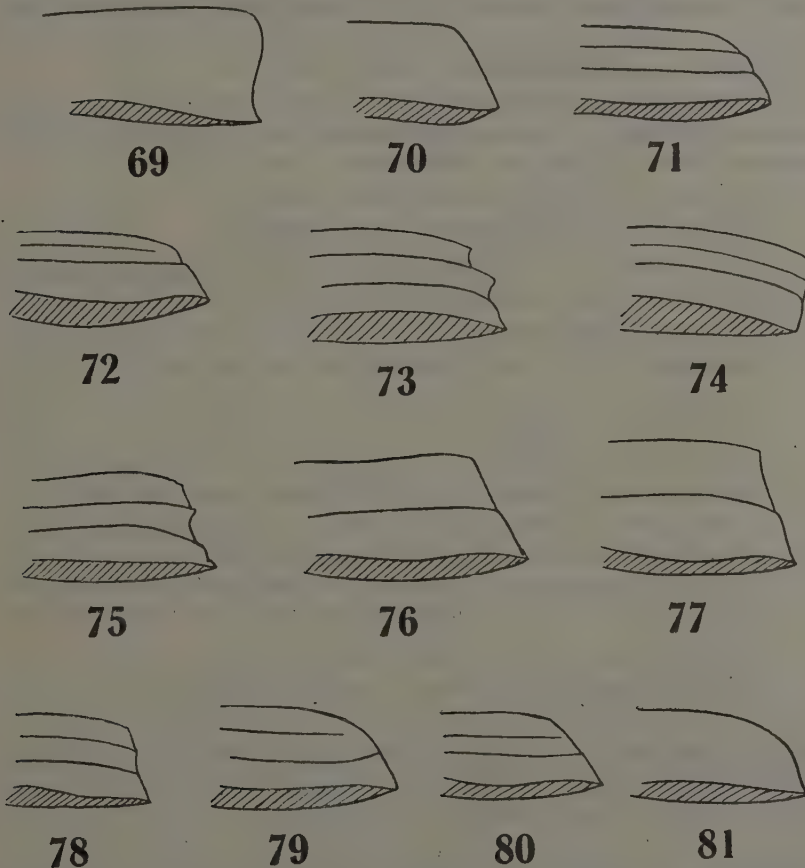
Distribution : Ethiopian region and northern parts of the South African region (Egypt, south-western Arabia, Sudan, Senegal, Abyssinia, Erythrea, Somaliland, British East Africa, Tanganyika Territory, Belgian Congo, Southern and Northern Rhodesia, Angola, Bechuanaland, Ovamboland, Portuguese East Africa, Transvaal, Madagascar <sup>(5)</sup>).

<sup>(4)</sup> With regard to the latter, I should like to refer to a critical note by Gebien, 1937a, in which this author has expressed a quite wrong view of the intra-generic systematics of *Pogonobasis*. He considers the great variability of the morphology in *Pogonobasis* to be a more or less irregular and individual variability, taking the different species to represent merely variable forms of one or two widely spread species. Mislead by this prejudice he doubted also the specific value of the three species *rhodesiana*, *bechuana* and *similis*, described by Hesse, 1935, from northern Bechuanaland. From the examination of the typical material of these species, I was able to completely confirm Hesse's opinion, as all three forms are in fact specifically different from one another. Hesse's conception of the occurrence of several valid species at the same locality, has furthermore been confirmed by the results of my own studies, as I was able to find three highly differentiated species to occur at the same locality in M'Bambey in the Senegal territory (*rugulosa* Sol., *senegalensis* n. and *opatra* n.), in Sandoa in the Belgian Congo (*nigrosetosa* subsp. *sandoana* n., *distincta* n. and *brevicornis* n.), whereas even four species have been collected together in Albertville in the Belgian Congo (*seriepilosa* Geb., *submarginata* n., *denticollis* n. and *bisinuata* n.). The specific value of these forms, occurring at the same locality, is beyond doubt; whether they belong to different phylogenetic lines or not, I am not able to state on the basis of the examined material, which is comparatively insufficient as to the practicability of intra-specific investigations. There is, however, a strong supposition that subspecific chains may exist within the genus, as I have suggested with regard to the species *verrucosa* Erichs., *similis* Hesse and *opatra* n.

<sup>(5)</sup> Gebien, 1938, describes the new subspecies *litoralis* to *ovata* (Fahr.) from Sinclair in Great Namaqualand; so far I have never seen material of this genus from so far south a territory as Great Namaqualand.

**Adelostomoid Eurychorini**

Prothorax without or with alate or foliaceous lateral portions; in the latter case the basal surface, in sectional view, bare or with scattered hairs, but often with ciliate margins; the alate lateral portions situated at about level of the middle of foramen, but constantly at a lower level than that of the upper margin of foramen; the edges of the alate lateral portions with an upper and an inferior carina, or only with an inferior one, and with the latter extending to the middle of foramen, where it is in contact



Figs. 69 to 81 : Contours of elytra in exact lateral aspect with formation of apical declivity in : (69) *Eutichus Wahlbergi* Haag; (70) *Psaryphis nana* Erichs.; (71) *Platysemodes benguelensis* (Haag); (72) *Platyphanus similis* (Haag); (73) *Acestophanus elongatus* (Haag); (74) *Acestophanus lanuginosus* (Haag); (75) *Acestophanus kaokoanus* n.; (76) *Smiliophanus steiroides* (Haag); (77) *Smiliophanus Vansoni* n.; (78) *Geophanus plicicollis* Fairm.; (79) *Geophanus pygmaeus* (Erichs.); (80) *Geophanus aemulus* Hesse; (81) *Geophanus parvulus* Péring.



with the foraminal margination, except for two species of *Prunaspila*; basal foramen of prothorax transversely oval, seldom roundish (cf. figs. 28-38). Pronotum with dense sculpture and in most of the species with discal carinae. Mesosternum bilevelled and with median carina on the depressed basal portion (cf. fig. 12), with exception of *Lepidochora*, in which it is uniformly horizontal and not carinate (cf. plate I, fig. 13). Epipleural carina absent or variously developed; with or without stridulatory organ. Antennae from subcylindrical to strongly compressed, with ten joints, in some genera, however, with rudimentary eleventh joint; with the apical margin of the tenth joint either straightly truncate or angulate, except for *Prunaspila*, in which it is dentate as in the *Eurychora*.

*Distribution*: On the whole African continent (also in the Sahara and the atlasic parts of Morocco), Madagascar, in western Arabia, the mediterranean portion of Asia, and in Southern Spain.

#### Stridulating adelostomoid *Eurychorini*

- 12(10) Tibial calcares much longer than the spinulae of coronula, with the calcares of posterior tibiae as long as the penultimate joint of posterior tarsi, or longer (cf. figs. 51, 52). Antennae small and slender, subcylindrical, with the dorsal and ventral surfaces hardly broader than the lateral ones (cf. figs. 49, 50). Elytra not costate (cf. plate VIII, figs. 157, 158). ..... 13
- Tibial calcares minute, those of posterior tibiae not longer than the spinulae of coronula and much shorter than the penultimate joint of posterior tarsi (cf. fig. 53). Antennae large, shaped as in *Eurychora*, strongly compressed, with the dorsal surface about twice as broad as the lateral ones (similar to figs. 16, 17). Elytra costate (cf. plate VII, figs. 153-156). ..... ***Prunaspila* Koch, 1950 (olim *Aspila* Fahr. 1870)**

*Type species*: *Aspila bicostata* Fahr., 1870.

The genus *Prunaspila* seems to be somewhat intermediate between the adelostomoid and eurychoroid *Eurychorini*. The alate lateral portions of prothorax, examined in sectional view, are situated almost at level with the upper margin of foramen, and the inferior carina of the prothoracic base is in some species abruptly abbreviated in front of the foraminal margination, in some others obsoletely produced towards the latter and in contact with it. The antennae are shaped as in *Eurychora* or *Pogonobasis*, with dentate apical margin of the sclerotized part of the apical joint. The apical margin of the buccal fissure lobes is triangular as in *Pogonobasis*. *Aspila septentrionalis* Gridelli, 1939, from Abyssinia is a *Psaryphis* and has probably to be synonymized with *Ps. nana* Erichs.

Distribution: Several species in a strictly limited area of the north-eastern part of Southern Africa (Portuguese East Africa, Southern Rhodesia, Transvaal, and Griqualand West). Key to species see pages 85-87.

- 13(12) Antennae shorter than the head is broad, with the basal joint shaft-like and about as long as the two following joints taken together, and with the second joint distinctly longer than the third one; the latter and all the following joints transverse (cf. fig. 50). Tibial calcares very long, those of posterior tibiae about as long as the two proximal joints of posterior tarsi combined; ungual joint of the latter as long as the two previous joints combined (cf. fig. 51). Upper surface of head without median carina. Pronotum broad, with simple lateral edges, the base as broad as elytral base and hardly lobiform at middle, the lateral surfaces sloping downwards, and the sides dilated towards posterior angles (cf. plate II, fig. 97). Antennal sulcus on episternum of prosternum shallow, but indicated (cf. plate II, fig. 97). Elytra roundish, only faintly convex, uniformly and shortly setulose, with sharp, serrate-denticulate and ciliate lateral edges (cf. plate VIII, fig. 157). ..... **Cimiciopsis n. gen.** ✓

Type species: *Cimiciopsis Castleae* n. sp. (cf. plate VIII, fig. 157).

Together with another new species, *C. atra*, endemic to the coastal region of the Southern Namib on both sides of the Orange River.

- Antennae slender and a little longer than the head is broad, with the basal joint shorter than the two following joints combined, and with the second joint shorter than the third one; the latter about twice as long as broad and one and a half times as long as the fourth joint; all the following joints longer than broad (cf. fig. 49). Tibial calcares short, those of posterior tibiae much shorter than the two proximal joints of posterior tarsi taken together and about half the length of the basal joint or shorter; ungual joint of posterior tarsi elongate, distinctly longer than the two previous joints combined (cf. fig. 52). Head on vertex with long and sharp median carina. Pronotum slender, with thickened, somewhat duplicate lateral edge, the base much narrower than elytral base and with strongly produced median lobe, the lateral surfaces distinctly bent upwards, and the sides being narrowed in front of posterior angles (cf. plate VIII, fig. 158). Antennal sulcus absent. Elytra broadly oval, narrower, convex, without distinct lateral edge, but with longitudinal rows of sparse granules along sides; integument covered with sparse adherent, somewhat scaly setae, and on each elytron, apart from the very long lateral cilia, with five longitudinal rows of very long and erect fine hairs,

as in some species of *Eurychora* (cf. plate VIII, fig. 158). . . . .

**Pogonocanta n. gen.**

Type species: *Pogonobasis longipilis* Fairm., 1894 (cf. plate VIII, fig. 158).

Monotypical genus.

The apical margin of the buccal fissure lobes is slightly emarginate in front of the outer angles, as the latter are situated at a lower level than the infra-epistomal lateral ridges (in *Cimiciopsis* it is straightly truncate). The sclerotized part of the apical joint of antennae is more distinctly angulate than in *Cimiciopsis*.

Distribution: Endemic in the South-Western Cape Province and Little Namaqualand.

14 (9) Antennal joints distinctly pedunculate (cf. plate VIII, figs. 159-161). . . . . 15

— Antennal joints closely fitted one into the other (cf. plate IX, figs. 162-167; plate X, fig. 169). . . . . 16

15(14) Sides of pronotum and elytra, as well as the head densely covered with a layer of round and adherent yellowish scales, which conceal the respective background of cuticula. Pronotum subconically narrowed towards anterior margin, closely fitted into the basal emargination of elytra and enclosed by the produced humeral portions of the latter. Tibial calcares of intermediate and posterior legs longer than the penultimate joint of the respective tarsi (cf. plate VIII, fig. 161). . . . . **Argasidius Péring, 1899.**

Type species: *Argasidius squamosus* Péring., 1899.

Monotypical genus.

Distribution: Strictly confined to Bushmanland, Little Namaqualand and Griqualand West.

— Integument of body sparsely and uniformly covered with short setae, leaving the background of cuticula completely exposed. Pronotum transverse, with the anterior margin only a little narrower than base, separated from elytra and not enclosed by the shoulders. Tibial calcares of intermediate and posterior legs shorter than the penultimate joint of the respective tarsi (cf. plate VIII, figs. 159, 160). . . . . **Smiliophanus Koch, 1950 (olim Smiliotus Haag, 1872)**

Type species: *Smiliotus steiroides* Haag, 1872 (cf. plate VIII, fig. 159).

The type species is supposed to occur in the Cape Province; so far no exact locality is known. Another new species, *S. Vansoni* (cf. plate VIII, fig. 160), comes from Little Namaqualand.



16(14) Episternum of prosternum with antennal sulcus (cf. figs. 54, 55, 66-68). Pronotum roundish, one and a half times as broad as head, about the width of elytra or only a little narrower, with strongly rounded sides, foliaceous and flattened lateral surfaces, and with sharp lateral

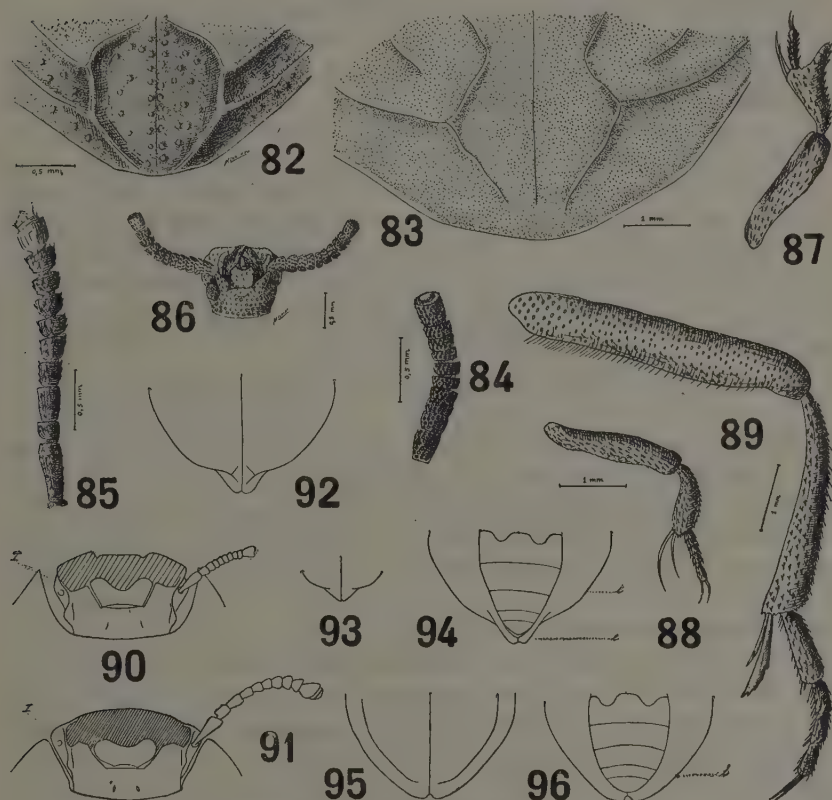


Fig. 82 : *Stipsostoma holgatensis* n., arrangement of costae on apical declivity of elytra. — Fig. 83 : *Phytostoma limpopoana* n., arrangement of costae on apical declivity of elytra. — Fig. 84 : *Basilewskyum stenosoide* n., antenna. — Fig. 85 : *Stipsostoma holgatensis* n., antenna. — Fig. 86 : *Basilewskyum stenosoide* n., underside of head with antennae. — Fig. 87 : *Cimicia spinipes* Fairm., anterior leg in lateral aspect. — Fig. 88 : *Cimicia spinipes* Fairm., intermediate leg in lateral aspect. — Fig. 89 : *Lepidochora diaphana* Koch, posterior leg in lateral aspect. — Fig. 90 : *Cimicia spinipes* Fairm., underside of head, with antenna (*l* : infra-epistomal lateral ridge). — Fig. 91 : *Cimicichora crenulata* n., underside of head with antenna (schematic) (*l* : infra-epistomal lateral ridge). — Fig. 92 : *Arthrochora arenicola* Geb., apical portion of elytra (schematic). — Fig. 93 : *Cimicia spinipes* Fairm., apical portion of elytra (schematic). — Fig. 94 : *Arthrochora arenicola* Geb., underside of afterbody (schematic) (*l* : lateral edge of elytra; *e* : epipleural carina). — Fig. 95 : *Cimicichora crenulata* n., apical portion of elytra (schematic). — Fig. 96 : *Cimicichora crenulata* n., underside of afterbody (schematic) (*l* : lateral edge of elytra).

- edge (cf. plate IX, figs. 163-167; plate X, fig. 169). Elytra subparallel, hardly broader behind middle than at base (cf. plate IX, figs. 163-167; plate X, fig. 169); apical declivity, in lateral aspect, convex to perpendicular (cf. figs. 70-81). ..... 17
- Episternum of prosternum without antennal sulcus. Pronotum quadrangular, only a little broader than head, much narrower than elytra and only a little more than half as broad as the latter, with the sides almost straightly and gradually narrowed towards base, uniformly convex and without flattened lateral surfaces, and with very fine, obsolete lateral edge (cf. plate IX, fig. 162). Elytra slightly pyriform, with the sides strongly narrowed towards base, broadest behind middle, and there nearly twice as broad as basally (cf. plate IX, fig. 162); apical declivity concave in front of the slightly projecting caudate apex (cf. fig. 69). ..... **Eutichus Haag, 1872.**

Type species: *Eutichus Wahlbergi* Haag, 1872 (cf. plate IX, fig. 162).

I have some doubts in referring a single specimen from Great Namaqualand (Stamprietfontein, August 1948, leg. University California-Transvaal Museum Expedition) to the type species. It agrees perfectly with the descriptions of the genus and species (Haag, 1875, pages 417 and 418), but not with the differential diagnosis in the key to the genera (Haag, loc. cit., page 362). There Haag places *Eutichus* to the genera having an antennal sulcus on the episternum of prosternum. The specimen from Stamprietfontein, however, has no antennal sulcus at all. In spite of this contradiction I believe to have interpreted *Eutichus* correctly, as I suppose some lapse has occurred in Haag's monograph. I base my opinion on the fact that the development of an antennal sulcus only takes place in such species, in which the lateral surfaces of prothorax are dilated and more or less foliaceous. In *Eutichus*, however, the prothorax is subcylindrical and not dilated laterally; the episternum of prosternum therefore is small and not wide enough to allow for the formation of an antennal sulcus. Moreover Haag does not mention with a single word this structure in his descriptions of *Eutichus* and *Wahlbergi*, whilst he describes it carefully in *Geophanus* and *Platyse-mus*.

*Eutichus* is a monotypical genus, described from the Swakop-region in South West Africa.

- 17(16) Antennal sulcus well pronounced, situated at middle of episternum and running in an oblique direction from the inner angle of the anterior emargination of prothorax towards posterior angles (cf. figs. 55, 66, 67). Anterior emargination of prothorax deep, enclosing the head up to level of eyes and concealing the neck with the tempora (cf.

- plate IX, figs. 163, 165-167; plate X, fig. 169). Antennae less incrassate, rarely with transverse third joint (cf. figs. 57-59). ..... 18
- Antennal sulcus obsolete, situated close to the lateral margin of episternum and running parallel with the latter (fig. 54). Anterior emargination of prothorax shallow, leaving exposed the neck and tempora (cf. plate IX, fig. 165). Antennae strongly incrassate, with all joints, the third one included, strongly transverse (cf. fig. 54; plate IX, fig. 165). ..... **Psaryphis Erichs., 1843.**

Type species: *Psaryphis nana* Erichs., 1843.

Monotypical genus, described from Angola.

The type species seems to be widely distributed. Apart from locotypical specimens from Angola (Benguela, ex coll. Mouflet and Baden, in Z. St.S.), I was able to examine material from Southern Rhodesia (Bulawayo, 11 November 1922, leg. Swinburne and Stevenson, T.M.) and British East Africa (Stony Athi, August 1940, Biological Survey, C.M.). There are a few more specimens with the doubtful locality "Griqualand?, leg. Dr. Brauns", in T.M.

*Aspila septentrionalis* Gridelli, 1939, from Abyssinia, is, according to a paratypical specimen (ex coll. Museum Budapest) a *Psaryphis* and does not seem to differ specifically from the widely spread *Ps. nana*; it may be synonymized with *Ps. nana*, though definite certainty on this synonymy can only be obtained through a close study of Erichson's holotype, which I was unable to examine.

Distribution: Eastern part of the Ethiopian region (Abyssinia, British East Africa) and northern part of the South African region (Angola and Southern Rhodesia).

- 18(17) Second joint of antennae small, shorter than the third joint; the latter square or a little longer, distinctly longer than the fourth joint (cf. figs. 57, 59). ..... 19
- Second joint of antennae large, much longer than the third joint and along the outer margin only a little shorter than the third and fourth joints combined; the third joint not longer than the fourth one; all intermediate joints, following the second one, are transverse (cf. fig. 58). ..... **Platysemodes Strand, 1935 (olim Platysemus Haag, 1872)**

Type species: *Platysemus benguelensis* Haag, 1872 (cf. plate IX, fig. 165).

Monotypical genus.

I know only the holotype and a paratype (ex Z.St.S.) from Angola (Benguela).



- 19(18) Underside of head with deep antennal sulcus, which is continuous with the excavate antennal sulcus on episternum of prosternum; the latter dilated apically and there completely closed in, with sharp and steep margins (cf. figs. 55, 67). Pronotum on each side of lateral surfaces with a longitudinal sulcus, situated exactly above the place, where the antennal sulcus runs underneath (cf. plate IX, fig. 163). Stridulatory carina on reflected portion of elytra with a deep sulcus along its outer margin (cf. fig. 67). Abdomen impunctate laterally. ...  
 ..... **Platyphanus n. gen.** ✓

Type species : *Acestus similis* Haag, 1878 (cf. plate II, fig. 98; plate IX, fig. 163).

The new and monotypical genus comes closest to *Acestophanus*, but it is distinguished not only by the particulars mentioned in the key, but also in the quite different, much thinner and shorter antennae, the third joint of which is distinctly shorter than the two following joints taken together; the longer basal joint of posterior tarsi, which is as long as the ungual joint (much shorter than that in *Acestophanus*); the less compressed and apically moderately dilated posterior tibiae, the apical margin of which is as broad as the basal joint of posterior tarsi is long (in *Acestophanus* the tibiae resemble those in *Smiliophanus*; they are strongly compressed and considerably dilated towards apex, with the apical margin a little broader than the two proximal joints of posterior tarsi are long together). The arrangement of the costal elements of elytral sculpture is different : the inner dorsal ridge is much more approximate to the humeral ridge than in *Acestophanus*, in which it is situated on about middle of each elytron; the two inner ridges are not coalescent apically, while they communicate on top of the apical declivity in *Acestophanus*; the intervals between the inner ridge and the humeral one, and those between the latter and the lateral ridge are tending to develop supplementary longitudinal ridges along midline (without this tendency in *Acestophanus*).

Distribution: South western part of Southern Africa (Karoo, Little and Great Namaqualand, Southern Kalahari, Bushmanland, Griqualand West, Gordonian).

- Underside of head without prolonged antennal sulcus. Antennal sulcus on episternum of prosternum well developed, but less excavate, not dilated towards apex and open apically, as it becomes gradually flattened and evanescent towards posterior margin of episternum (cf. fig. 66). Pronotum without sulcus on lateral portions. Stridulatory carina on reflected portions of elytra simple, without sulcus along outer margin (cf. plate IX, figs. 166, 167; plate X, fig. 169). Abdomen uniformly punctured. .... 20

- 20(19) Antennae long, with the third joint elongate, as long as the two following joints taken together, or a little longer (cf. fig. 57; plate IX, fig. 166). Tibiae strongly compressed and conspicuously dilated towards apex; the apical margin of the lateral surface of posterior tibiae a little longer than the two basal joints of posterior tarsi taken together (cf. fig. 60; plate IX, fig. 166). .....  
 ..... **Acestophanus Koch, 1950 (olim Acestus Haag, 1872)**

Type species: *Acestus elongatus* Haag, 1872 (cf. plate IX, fig. 166).

Three species, viz., *elongatus*, *lanuginosus* Haag, 1872, and *kaokoanus* n. (cf. plate IX, fig. 167), ranging from the western Cape Province northwards up to the Kaokoveld.

- Antennae short, with the third joint much shorter than the two following joints combined (cf. figs. 59, 66; plate X, fig. 169). Tibiae less compressed and moderately dilated towards apex; the apical margin of posterior tibiae about as broad as the basal joint of posterior tarsi is long or a little longer (cf. plate X, fig. 169). .....  
 ..... **Geophanus Haag, 1872.**

Type species: *Psaryphis pygmaea* Erichs., 1843 (cf. plate X, fig. 169).

The following species are known: *pygmaeus* (Erichs.); *plicicollis* Fairm, 1888; *tristis* Haag, 1872; *sepulchralis* Haag, 1872; *parvulus* Péring., 1908; *foveatipennis* Péring., 1908; and *acmulus* Hesse, 1935. Many inedited species have still to be studied.

*Geophanus meridionalis* (Ancey) belongs to the new genus *Aspilomorpha*.

Distribution: Widely spread over the whole of Southern Africa.

#### Not stridulating adelostomoid Eurychorini

##### Herpsis - group

*Epipleural carina of elytra absent or only apically developed. Basal joint of antennae much shorter than the two following joints combined. Tibial calcares of posterior legs much shorter than the respective claws. Body subparallel.*

- 21 (4) Antennae strongly incrassate, about as broad as the dorsal portion of eyes is long; apical margin of the sclerotized part of the apical joint angulate as in the stridulating adelostomoid Eurychorini (cf. fig. 56). Genal canthus convex, not carinate, and broad; in lateral aspect, between ocular portions about as broad as the length of the dorsal part of eyes (cf. fig. 64); in dorsal aspect, narrowed towards the middle of eyes, thence subparallel and in line with tempora (cf. fig. 62). Pronotum subcylindrical, with the base much narrower than

elytral base (cf. plate X, fig. 168). Episternum of prosternum obliquely sloping from the lateral margin inwards, without flattened lateral portions and without antennal sulcus. Elytra without lateral edge; each elytron with three indicated longitudinal ridges dorsally (cf. plate X, fig. 168). ..... **Herpsis Haag, 1872.**

Type species: *Adelostoma rugosum* Gory, 1829-1838 (cf. plate X, fig. 168).

Monotypical genus, described and so far only known from the Senegal-territory.

I was not able to examine the structure of the prothoracic base, as only a few specimens were available to me (ex Z.St.S. and S.A.M.).

Although much recalling *Adelostoma*, this genus differs essentially from the latter by the angulate sclerotized base of the tenth antennal joint, which is truncate in *Adelostoma*.

- Antennae moderately incrassate, narrower than the dorsal part of eyes is long; apical margin of the sclerotized part of the apical joint truncate (cf. plate X, fig. 171). Genal canthus smaller and carinate along midline between ocular parts; in lateral aspect, between ocular parts, much narrower than the dorsal portion of eyes is long (cf. fig. 65); in dorsal view straightly narrowed to posterior margin of eyes (cf. fig. 63). Pronotum cordiform, with the base as broad as elytral base (cf. plate X, figs. 170, 171). Episternum of prosternum with indication of a smoothed antennal sulcus; the lateral portions flattened and somewhat foliaceous. Lateral edge of elytra sharply carinate; each elytron with two subcostate dorsal carinae (cf. plate X, figs. 170, 171). ..... **Falsaspila n. gen.** ✓

Type species: *Adelostoma Batesi* Haag, 1872 (cf. plate X, fig. 171).

So far I have found three species of *Adelostoma*, which have to be placed to the new genus, viz.: *Batesi*; *abyssinicum* Haag, 1872; and *hirsutum* Koch, 1935 (\*).

(\*) Gridelli, 1939, declared *Ad. hirsutum* to be a synonym of *abyssinicum*, without having taken the care to examine the respective types. As the descriptions of the two species differ, I have forwarded the holotype of *Ad. abyssinicum* (ex Z.St.S.) to Prof. Dr. H. Priesner, Cairo, for comparison with the type of *hirsutum*, kept in the collection of the Entomological Section of the Ministry of Agriculture at Dokki (Egypt). Here the results of that comparative study (Priesner in litt., November 7th, 1950, cit.):

*abyssinicum* Haag

Lg. 4.6-4.7 mm.

Zwischen Naht und erster Rippe der Decken sind die Punkte in vier Längsreihen angeordnet; diese Porenpunkte sind grösser.

Die Decken lassen nur einzelne Borsten erkennen.

*hirsutum* Koch

Lg. 5.6 mm.

Zwischen Naht und erster Rippe sind die Porenpunkte kleiner und viel weniger regelmässig, nicht in Längsreihen angeordnet.

Der ganze Körper lang abstehend beborstet.

Weitere Unterschiede kann ich nicht finden. Die beiden Holotypen sind m. E. mindestens rassistisch verschieden.

**Distribution:** North-eastern part of the Ethiopian region (Anglo-Egyptian Sudan, Abyssinia, Erythrea, and south-western part of Arabia).

Gridelli, 1939, supposed the group of *Ad. Batesi* (or *hirsutum*) to represent a new genus, standing near to *Prunaspila* (olim *Aspila*). Although his opinion is correct as to the necessity of creating a new genus, Gridelli is quite wrong about the systematic position of the latter. Neither having read the description of *Aspila*, nor having seen a single specimen of this genus, he completely misinterpreted *Prunaspila*, in referring to it his Abyssinian species *septentrionalis*, which, in fact, is a *Psaryphis* and hardly different from the widely spread and only species of this genus, viz., *P. nana* Erichs.

*Falsaspila* has nothing in common with *Prunaspila*, which belongs to a quite different group of the adelostomoid Eurychorini. It differs from *Prunaspila*, besides the many essential characters indicated in the key, in the following particulars. The sides of the cordiform pronotum are longitudinally straight in front of the posterior angles (in *Prunaspila* the sides of pronotum are strongly rounded and narrowed towards base, subangularly curved towards the posterior angles, and in front of them often running almost in the same transverse direction as the base itself and almost in line with the latter). The lateral edge of pronotum is not denticulate as in *Prunaspila*. The antennae are subcylindrical; the third joint is only very little longer than the previous or the following joints, and much shorter than the two following joints taken together; the apical margin of the sclerotized part of the apical joint is straightly cut off; the sensorial part of the same joint is simple and uniformly membranaceous; the single joints are subpedunculate. In *Prunaspila* the antennae are strongly compressed and subserrate; the third joint is elongate, distinctly longer than the second or the fourth joint, and often as long as the two following joints taken together; the apical margin of the sclerotized part of the apical joint is dentate, as in *Eurychora*; the sensorial part of the same joint has a diagonal sclerotized ridge across its membranaceous surface, running between the two dentiform angles of the apical margin of the sclerotized part of joint; all joints are closely fitted into one another.

#### Adelostoma - group

*Epipleural carina of elytra complete, extending from apex of elytra up to humeral angle* (cf. fig. 4).

- 22 (2) Prothorax without distinctly foliaceous lateral portions (cf. plate X, figs. 172, 173); the episternum of prosternum therefore plane, gradually raised towards lateral margin, and without antennal sulcus (cf. plate III, figs. 111, 112). Lateral edge of pronotum simple (cf.



- plate III, fig. 112). Apical margin of the sclerotized part of the tenth antennal joint straightly cut off (cf. figs. 84, 86). ..... 23
- Prothorax with foliaceous lateral portions (cf. plate X, figs. 174-177; plate XI, figs. 178-181); episternum of prosternum steeply bilévelled along midline, with variously shaped antennal sulcus (cf. fig. 68; plate II, fig. 105). Apical margin of the sclerotized part of the tenth antennal joint angulate, except for *Stipsostoma* n., in which it is truncate (cf. fig. 85), but in this case the lateral edge of pronotum duplicate (cf. plate II, fig. 105). ..... 24
- 23(22) Antennae eleven-jointed (cf. fig. 84). Eyes not completely divided, with the large ventral part compounded of eight to ten rows of corneal facets (cf. fig. 86; plate III, fig. 111). Submentum almost square, separated from buccal fissure lobes by a deep slit of the oral cavity (cf. fig. 86). Metasternum one and a half times as long as basal sternite of abdomen (cf. plate III, fig. 111); the latter with sharply attenuate and triangular intercoxal process; episternum linearly elongate, with a longitudinal row of punctures (cf. plate III, fig. 111). Upper surface of head without median carina, pronotum with four carinae, elytra with eight costae (cf. plate X, fig. 172). ...  
..... **Basilewskyum** n. gen. (7) ✓

Type species: *Basilewskyum stenosinoide* n. sp. (cf. plate X, fig. 172).

The new monotypical genus is the most abnormal genus among the Eurychorini; it is to some extent intermediate between the latter and Stenosiini, obscuring the systematical limits between both tribes.

Distribution: Belgian Congo.

- Antennae ten-jointed (cf. plate X, fig. 173). Eyes completely divided, with very small ventral part, which is reduced to only a few corneal facets (cf. plate III, fig. 112). Submentum transversely trapezoidal, separated from buccal fissure lobes by simple sutures. Metasternum much shorter than the basal sternite of abdomen; the latter with the intercoxal process subtruncate, but triangularly produced at middle; episternum broad, often hardly separated from metasternum, and covered with a dense and irregular, often rugose sculpture (cf. plate III, fig. 112). Upper surface of head with median carina, pronotum

(7) I do not know the monotypical genus *Brachymoschium* Fairm., 1896, from Madagascar. According to the description it is characterized by the quadricarinate pronotum, as it is the case in *Basilewskyum*; but in all the other characters indicated, it differs much from the latter. As I was unable to see the holotype, it is impossible to judge the systematic position of this genus by the description only.

with two carinae, elytra with six costae (cf. plate X, fig 173). .....  
 ..... **Adelostoma Dup., 1827**

Type species: *Adelostoma sulcatum* Dup., 1827 (cf. plate X, fig. 173).

All the mediterranean species belong to *Adelostoma* s. m. From the Ethiopian and South African species I know only *Ad. angustius* Fairm., 1893, whereas *abbreviatum* Haag and *pygmaeum* Haag, and *Batesi* Haag, *abyssinicum* Haag and *hirsutum* Koch, have to be referred to the new genera *Psaryphulum* and *Falsaspila* respectively. The species I was unable to examine are the following: *curtum* Haag, 1878 (without patria, probably a *Geophanus*); the Arabian species *bicarinatum* Wat., 1881 (from Socotra), *Granti* Gah., 1900 (from Socotra) and *grandicollis* Fairm., 1890 (from the island of Camaran); *crenatocostatum* Geb., 1920 (from Portuguese Guinea); and the three species *curtipenne*, *erythraeum* and *Facciae*, Gridelli, 1939, has described from Erythrea and Italian Somaliland; whether these species belong to *Adelostoma* s. m. or not, can only be decided by the examination of typical material, as the descriptions concerned do not indicate the essential particulars.

Distribution: Southern Spain, Northern Africa (the atlantic province included), mediterranean parts of Asia, northern parts of the Ethiopian region (the south-western parts of Arabia included), Saharian region.

- 24(22) Eyes completely divided by the genal canthus. Supra-orbital carinae obliquely prolonged towards middle of vertex, convergent. Sides of elytra bare or shortly setose. .... 26  
 — Eyes constricted by the genal canthus, but not divided. Supra-orbital carinae short, straight, subparallel and confined to the inner margin of eyes. Sides of elytra furnished with long cilia. .... 25  
 ..... **Machloopsis Pom., 1871**

In *Machloopsis* the basal joint of antennae is shaft-like as in the *Stips*-group, but the apical margin of the sclerotized part of the apical joint of antennae is angulate.

- 25(24) Base of pronotum deeply emarginate at each side of middle; disc of pronotum with two median carinae. Elytra flat, covered with punctures, and between punctures with scattered and fine granules; the base much narrower than pronotal base, with the humeral angles fitting into the lateral emarginations of pronotal base, and embraced by the posterior angles of pronotum. Basal joint of antennae much longer than apical joint. .... **Machloopsis subg. Machloopsis**

Type species: *Eurychora Levallanti* Luc., 1850.

Several species in the Mediterranean region of Northern Africa and Asia.

*M. crenatocostata* (Redtb. 1868), (cf. plate X, fig. 174), has been described from the "Vorgebirge der guten Hoffnung"; Gridelli, 1930, compared the holotype with North African specimens and rectified the erroneous type locality.

- Sides of pronotal base straight, without emargination; disc of pronotum without carinae. Elytra convex, uniformly covered with sparse and fine granules; the base exactly as broad as pronotal base, with the humeral angles distinctly projecting beyond the lateral outlines of pronotum. Basal joint of antennae a little longer than apical joint....  
..... ***Machlopsis* subg. *Hidrosella* nov.**

Type species: *Hidrosis incostata* Haag, 1872.

According to the holotype of *incostata* (ex Z.St.S.), this species differs at least subgenerically from the palearctic *Machlopsis*. Owing to the abbreviate and roundish body, and the granulate elytra, which show only one single serrate-denticulate submarginal carina on each elytron, the new subgenus resembles to some extent the South African genera *Cimicia* Fairm. and *Cimiciopsis* n.

Distribution: Senegal (Cape Verd); Español, 1944, records the same species from the Spanish Sahara (Seguiat El Hamra, and Rio de Oro).

26(24) Base of elytra broadly emarginate, either much narrower than pronotal base, or exactly as broad as the latter (cf. plate XI, figs. 178-181, 184, 185). ..... 27

Base of elytra much broader than pronotal base, straight or appearing as if slightly arcuate, as the lateral contours are more or less obliquely sloping towards the humeral angles (cf. plate X, figs. 175-177). .....  
..... ***Psaryphulum* n. gen.** ✓

Type species: *Adelostoma abbreviatum* Haag, 1872 (cf. plate X, fig. 177).

The new genus resembles *Psaryphis* Erichs. in the general appearance. From *Adelostoma*, it differs, besides the characters mentioned in the key, as follows.

The antennae are short, scarcely longer than the head is broad and much shorter than the pronotum is long; the single joints are closely fitting into one another; the apical margin of the sclerotized part of the apical joint is angulate or deeply emarginate at lateral surfaces (in *Adelostoma* the antennae are longer than the head is broad and longer than pronotum; all joints are distinctly pedunculate; the apical margin of the sclerotized part of the apical joint is truncate). The buccal fissure lobes are projecting from level of submental surface (flat and not projecting in *Adelostoma*). The in-

tercoxal process of the basal sternite of abdomen is rounded anteriorly, narrow and about as broad as the prosternal apophysis (in *Adelostoma* it is almost twice as broad as the prosternal apophysis, with the anterior margin subtruncate, but produced into a small triangular lobe at middle).

To *Psaryphulum* n. belong the two species *Ad. abbreviatum* and *pygmaeum* Haag, 1872, with the new ssp. *herero*, furthermore the new species *damara* and *Machadoi*.

Distribution: Northern parts of Southern Africa (Angola, Kaokoveld, Bechuanaland, Southern Rhodesia, northern Transvaal).

27(26) Pronotum closely jointed to elytra, with the middle of base overlapping the mesothoracic tergite (cf. plate XI, figs. 180, 181, 184, 185); lateral margination bicarinate (cf. plate II, fig. 105). Antennal sulcus on episternum of prosternum abbreviate, not extending to posterior margin of episternum. Elytra hardly narrowed towards the rectangular humeral angles, with the base about as broad as pronotal base; the open slit between humeral angles and posterior angles of pronotum very small; each elytron with only two dorsal carinae (cf. plate XI, figs. 180, 181, 184, 185); epipleural carina very sharp, smooth or only apically slightly crenulate or denticulate, bare. Intercoxal process of basal sternite of abdomen narrow, one and a half times as broad as long, or narrower. Basal joint of antennae more or less the length of the two following joints combined, longer than the apical joint or the third one (cf. fig. 85). ..... 28

— Pronotum loosely jointed to elytra, with the middle of base separated from elytral base and leaving the mesothoracic tergite more or less exposed; lateral edge simple (cf. plate XI, figs. 178, 179). Antennal sulcus on episternum of prosternum complete, extending backwards to the posterior margin of episternum. Elytra strongly narrowed towards the acute and produced humeral angles, with the base much narrower than pronotal base; the open space between humeral angles and posterior angles of pronotum wide; each elytron with three dorsal carinae (cf. plate XI, figs. 178, 179); epipleural carina faint, serrate-denticulate and setulose. Intercoxal process of basal sternite of abdomen about three times as broad as the prosternal apophysis. Basal joint of antennae short, about as long as the apical joint, very little longer than the third joint, and shorter than the second and third joints combined (cf. plate II, fig. 104). ..... **Aspilomorpha** n. gen. ✓

Type locality: *Aspilomorpha mediolobata* n. sp. (cf. plate XI, fig. 178).

To the same genus belong *Adelostoma meridionale* Ancey, 1881, which the author himself, a little later (1881a), transferred to *Psaryphis*, while



Gebien, 1937, referring to Fairmaire, 1887, listed it as *Geophanus*; furthermore the new species *Alfieri* (cf. plate XI, fig. 179).

Distribution: Tanganyika Territory and Belgian Congo.

- 28(27) The apical margin of the sclerotized part of the tenth antennal joint angulate; no rudimentary eleventh joint; the basal joint shorter than the two following joints combined; third joint square. The discal portion of pronotum, between median carinae, produced backwards, as well as forwards beyond the lateral portions of base and the anterior margin respectively (cf. plate XI, figs. 184, 185). Antennal sulcus deep, closed-in around. Dorsal costae of elytra wavy, sharp and smooth on top; no transverse carinula on top of the apical declivity between suture and inner dorsal carina, but with a short and rudimentary, longitudinal carinula on top of the apical declivity between dorsal carinae (cf. plate XI, figs. 184, 185); apical declivity without pentagonally delimited space (cf. fig. 83; plate II, fig. 102). Metasternum a little shorter than second sternite of abdomen and much shorter than the first one; uniformly convex, without carinately defined discal portions, as is the abdomen. Size smaller: 6 1/2 to 7 mm. long. .... **Phytolostoma n. gen.** ✓

Type species: *Phytolostoma limpopoana* n. sp. (cf. plate XI, fig. 184).

Monotypical genus.

Distribution: North-eastern part of Southern Africa (Northern Transvaal, Eastern Bechuanaland, Southern Rhodesia).

- The apical margin of the sclerotized part of the tenth antennal joint truncate as in the *Stips*-group; a small rudimentary eleventh joint is perceptible within the sensorial part of the tenth joint; the basal joint longer than the two following joints combined; the third joint one and a half times as long as broad (cf. fig. 85). The discal portion of pronotum, between median carinae, produced only backwards beyond lateral portions of base (cf. plate XI, figs. 180, 181). Antennal sulcus shallow, open towards the sides of prothorax. Dorsal costae on elytra straight, transversely granular on top; the inner costa united with suture by an obliquely transverse carinula on top of the apical declivity; no supplementary carinula between dorsal costae (cf. plate XI, figs. 180, 181); apical declivity with bordered pentagonal space at middle (cf. fig. 82; plate II, fig. 103). Metasternum longer than second abdominal sternite, and only a little shorter than the first one; discal part of metasternum and basal sternites raised, flattened and sharply carinate at sides, as in *Stips* (cf. plate II, fig. 107). Size larger: 9 to 13 mm. long. .... **Stipsostoma n. gen.** ✓

Type species: *Steira sculpta* Geb., 1920 (cf. plate XI, fig. 181).

In spite of the complete epipleural carina of elytra, the new genus seems to be closely related to the *Stips*-group. It agrees with the latter in the structure of the tenth antennal joint, the elongate basal joint of antennae, the carinate borders of the discal portions of metasternum and basal ster-

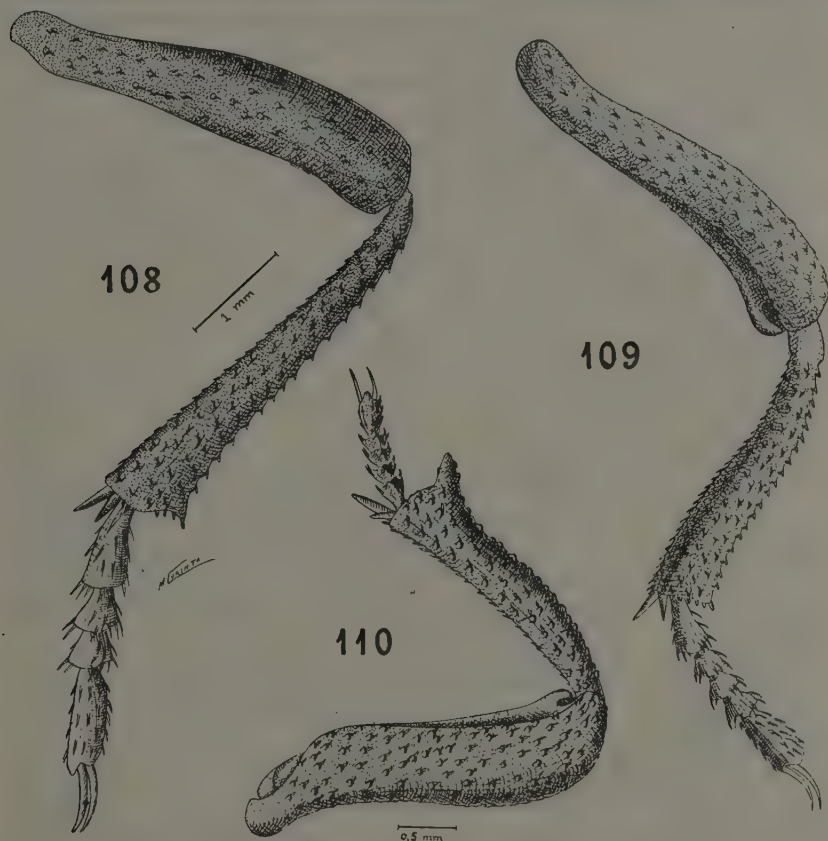


Fig. 108 to 110 : *Stipsosoma holgatensis* n. : (108) posterior leg; (109) intermediate leg; (110) anterior leg.

nites, and in the composition of the costal elements of sculpture on upper surface of body.

Apart from the type species, another species, viz. *holgatensis* n. (cf. plate XI, fig. 180) has been described in the present paper.

Distribution : Strictly confined to the Southern Namib, on both sides of the Orange River (north-western part of Little Namaqualand and south-western part of Great Namaqualand).

**Stips - group**

*Epipleural carina absent, in a few species apically developed* (cf. figs. 94, 96). Basal joint of antennae shaft-like, about as long as the two following joints taken together (cf. figs. 21, 90, 91). Tibial calcares of posterior legs longer than the respective claws (cf. figs. 24, 25, 87-89). Body round.

*Distribution*: In the western part of the South African region, in the North extending across Bechuanaland to the western parts of Southern Rhodesia. The centre of distribution is to be found in the Southern Namib.

- 29 (3) Mesosternum bilevelled; the basal portion with median carina (cf. fig. 12). Tibial calcares of intermediate and posterior legs, as usual, simply acuminate (cf. figs. 12, 24, 25, 87, 88, 121). Integument of upper surface of body bare or sparsely covered with bristles; the latter not concealing the background of cuticula (cf. plate XI, figs. 182, 183, 186; plate XII, figs. 187-193; plate XIII, figs. 194-196). Pronotum unicolorous, black to testaceous (cf. plate XI, figs. 182, 183, 186; plate XII, figs. 187-193; plate XIII, figs. 194-196). ..... 30
- Mesosternum evenly horizontal; the basal portion transversely wrinkled, without longitudinal median carina (cf. plate I, fig. 13). Tibial calcares, especially the longer ones, dilated towards apex, and with the apical margin obliquely truncate and irregularly digitate (cf. fig. 89). Integument of upper surface of body densely covered with a layer of whitish scales or hairs, which conceal to a high extent the background of cuticula (cf. plate XIII, figs. 197-200). Pronotum yellowish, with sharply defined, black discal portion (cf. plate XIII, figs. 199, 200). ..... **Lepidochora Geb., 1938.**

Type species: *Lepidochora Eberlanzi* Geb., 1938.

*Lepidochora* is the most specialized genus within the Eurychorini. Although essentially differing from all the other Eurychorini by the horizontal mesosternum and the digitate tibial calcares, I have no doubt that it belongs to the phylogenetic line of the *Stips*-group. So far the following forms are known: *Eberlanzi* Geb. (cf. plate XIII, fig. 199); *discoidalis* Geb., 1938; *pilosa* Koch, 1950 (cf. plate XIII, fig. 197); *diaphanus* Koch, 1950 (cf. plate XIII, figs. 198, 200).

The *Lepidochora* are some of the few insects, which have adapted themselves to the life in the barren shifting sand dunes of the Namib-desert. During the day they hide deeply in the sand under shrubs, under grasses or even in the barren sand on the leeward side of the dunes, where the wind deposits seeds, particles of plants and other organic substances; towards sunset they emerge from the sand gregariously to run around and copulate. As the *Onymacris* of the Namib-dunes, they seem to be very sensitive to concussions of the soil, being disturbed by the approaching footsteps of the observer from

far away; immediately they take refuge in the sand, and only a round convexity of the surface indicates the spot of their disappearance.

Distribution: Strictly confined to the sandy dunes of the Namib-desert, ranging from North of the Orange River up to the Swakop River.

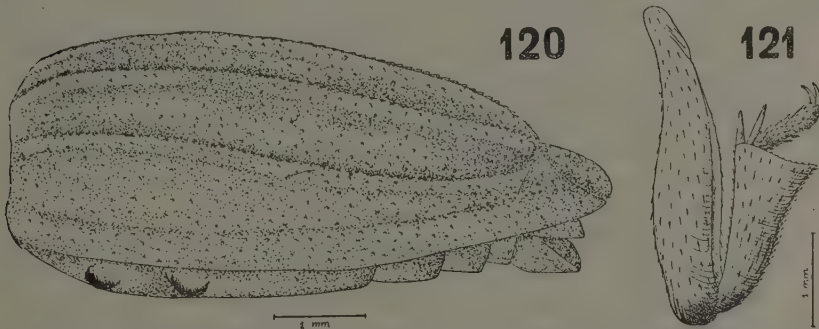
30(29) Disc of the pronotum, metasternum, basal sternites of abdomen and generally also of the head without sharp carinae (cf. plate XII, figs. 187, 190, 191, 193; plate XIII, fig. 195). . . . . 31

— Discal portion of the metasternum, the first three sternites of abdomen (cf. plate II, fig. 106), and pronotum, on each side delimited by a sharp, more or less granular carina (cf. plate XI, figs. 182, 183, 186; plate XII, figs. 188, 192); the discal carinae on pronotum in a single case evanescent (*Stips dorsocostata* Fairm.) (cf. plate XII, fig. 189). Head above with median carina. . . . .

**Stips Koch, 1950 (olim Steira Westwood, 1837)**

Type species: *Steira costata* Westw., 1837.

The epipleural carina is completely absent, except for *St. costata* (cf. plate II, fig. 106; plate XI, fig. 182) (with the subsp. *grandis* n.), in which it is strongly developed apically.



Figs. 120 and 121: *Stips Stali* (Haag): (120) afterbody in dorso-lateral view; (121) anterior leg.

The six sharply differentiated species have the following distribution:

*St. costata* (Westw.) (cf. plate XI, fig. 182): South of the Orange River (Great Karroo, Little Namaqualand, Bushmanland); *St. Dohrni* (Haag, 1872) (cf. plate XI, fig. 183): North of the Orange River (Kalahari, Damaraland, Bechuanaland, western part of Southern Rhodesia); *St. Stali* (Haag, 1872) (cf. plate XII, fig. 192): Great Namaqualand (inland-dunes of the Namib); *St. cassidioides* (Geb., 1920) (cf. plate XII, fig. 188): Southern Namib, on both sides of the Orange River (north-western part of Little Namaqualand and south-western part of Great Namaqualand); *St. dorso-*



*costata* (Fairm., 1902) (cf. plate XII, fig. 189) : Southern Angola; *St. Gebieni* (Hesse, 1935) (cf. plate XII, fig. 186) : Bechuanaland, Ovamboland, Southern Angola, western part of Southern Rhodesia, Kalahari, Gordonias, Griqualand West.

- 31(30) Elytra with separated caudal process apically (cf. figs. 92-94; plate XII, fig. 193; plate XIII, figs. 194-196); epipleural carina developed around anal sternite of abdomen (cf. fig. 94); lateral edges of elytra abbreviate apically and widely separated at apex (cf. figs. 92, 93); no submarginal carina on dorsal surface (cf. figs. 92, 93; plate III, figs. 117, 118). ..... 32
- Elytra without caudate process apically (cf. fig. 95, 96); epipleural carina absent (cf. fig. 96); lateral edges of elytra complete and coalescent at apex; dorsal surface with submarginal carina (cf. fig. 95; plate III, fig. 119; plate XII, figs. 187, 190, 191). ..... *Cimicichora* n. gen. ✓

Type species: *Cimicichora crenulata* n. sp.

Three strongly differentiated new species, which, in the costal arrangement of elytra resemble *Stips Gebieni*: *C. crenulata* (cf. plate XII, fig. 190), *C. Hessei* (cf. plate XII, fig. 191) and *C. gigantea* (cf. plate XII, fig. 187).

Distribution: In the red sandy dunes of the southern Kalahari and Bushmanland, as well as in the sand of the Lower Orange River (north-western part of Little Namaqualand).

- 32(31) Tibial calcares extremely enlarged, with the longer spur about the length of the respective tarsus (cf. figs. 87, 88; plate XII, fig. 193; plate XIII, fig. 194); apical margin of anterior tibiae as broad as the anterior tarsus is long, with the outer angle produced into a dentiform lobe (cf. fig. 87; plate XII, fig. 193; plate XIII, fig. 194); intermediate tibiae hardly longer than intermediate tarsi (cf. fig. 88). Antennae ten-jointed, small, considerably shorter than the head is broad (cf. fig. 90). The infra-epistomal lateral ridge curved towards the sides of head, in contact with the lateral margin of genae, and sharply separating the underside of the lateral lobes of epistome from the antennal infra-ocular groove. Pronotum with ciliate sides (cf. fig. 90). Lateral edge of elytra abruptly ending at some distance from suture (cf. plate III, fig. 118); caudate lobe of apex angular apically (cf. fig. 93). ..... *Cimicia* Fairm., 1891

Type species: *Cimicia spinipes* Fairm., 1891 (cf. Plate XII, fig. 193; plate XIII, fig. 194).

Very specialized monotypical genus, confined to the coastal strip of the Southern Namib, on both sides of the Orange River, ranging from Port Nol-

both northwards to Bogenfels in the south-western part of Great Namaqualand.

- Tibial calcares moderate, about half the length of the respective tarsus (cf. figs. 24, 25; plate XIII, figs. 195, 196); apical margin of anterior tibiae considerably shorter than the anterior tarsus, with simple and not projecting outer angle (cf. fig. 24); intermediate tibiae much longer than intermediate tarsi (cf. fig. 25). Antennae with rudimentary eleventh joint, a little longer than the head is broad (cf. fig. 91). The infra-epistomal lateral ridge shaped as in the other Eurychorini; running forwards and subparallel with the lateral outlines of head, in contact with the anterior margin of epistome, therefore the antennal infra-ocular groove open, extending to anterior margin of epistome and not divided from the underside of the lateral portions of the latter (cf. fig. 91). Sides of pronotum not ciliate. Lateral edge of elytra, at some distance from suture, forked into two short carinulae, with one of them running obliquely backwards towards apex of elytra, and the other one obliquely produced forwards towards suture (cf. fig. 92; plate III, fig. 117); caudate lobe of apex subtruncate apically (cf. figs. 92, 94). **Arthrochora Geb., 1938**

Type species: *Arthrochora arenicola* Geb., 1938 (cf. plate XIII, figs. 195, 196).

Monotypical genus, strictly confined to a small area of inland dunes of the Southern Namib, between Lüderitzbucht and the red sand dunes 70 miles north-west of Aus (western part of Great Namaqualand).

## DESCRIPTIONS

### *Lycanthropa dimorpha* n. sp.

(Plate IV, figs. 124, 125)

Black, sides of body reddish brown; moderately shiny; pilose. Head above rather densely covered with sharp granules, becoming scattered on inter-ocular space, and with some short semi-erect bristles, which are intermixed with a few long and fine erect hairs. The two median teeth of epistomal emargination strong. Supra-antennal portions hardly raised, with subparallel lateral outlines, broadly rounded with the lateral contours of epistome, obliquely narrowed towards eyes. The latter broad, almost round, with subparallel supra-orbital edges, and with the inter-ocular space almost three times as wide as the eyes are long. Anterior portion of submentum densely rugose. Antennae elongate, slightly accrescent towards apex; third joint conically narrowed towards base, a little more than three times as long as broad, and only a little shorter than the three following joints taken together;

fourth and fifth joints distinctly longer than broad; sixth and seventh joints about as long as broad; eighth and ninth joints slightly transverse, about one-third broader than long; apical joint comparatively small, hardly broader than the previous joint, and one and a half times as long as that. Pronotum nearly four times as broad as long, broadest between posterior angles, with very scattered and fine granules, becoming rougher and more distinct on lateral portions. Base of anterior emargination about twice as long as the inner lateral margin. Sides strongly rounded and dilated towards base, shortly and slightly narrowed in front of posterior angles; lateral edge sharply denticulate and furnished with long, erect and fine cilia of a yellowish tint. Base deeply bisinuate, with produced median lobe, and rather sharp, slightly prominent, rectangular posterior angles; furnished with a fringe of fine and long yellowish hairs at both sides of median lobe. Transverse impression of disc broad and complete; in front of it with a well-pronounced anterior convexity. Lateral surfaces faintly raised and, as on head, covered with a sparse and duplicate pilosity. Underside sparsely granulate; prosternal apophysis with a few short and erect hairs. Elytra a little broader than pronotum, in the ♂ almost as broad as long, in the ♀ oval and distinctly longer than broad. Base straight in the ♂, slightly arcuate in the ♀. Humeral angles obliquely rounded, with the lateral edge strongly bent upwards in the ♂, less so in the ♀. Sides behind humeral portion almost subparallel, strongly narrowed from middle to apex in the ♂, less so in the ♀. Lateral edge sharply and finely denticulate, slightly reflected in the ♂, hardly so in the ♀; furnished with long and very fine yellowish cilia. Apex not caudate. Convexity moderate, separated from lateral edge by a narrow submarginal depression in the ♂, without the latter and in contact with the lateral edge in the ♀. Integument covered with a fine and comparatively dense punctuation, intermixed with fine granules on the intervals between punctures; some of these granules are situated on top of slight, tuberculiform and roundish elevations of the cuticula. The pilosity consists of very short and erect bristles of the background, and of three longitudinal rows of sparse and long, fine, erect hairs on each elytron. Reflected portion flattened on lateral half, evenly covered with scattered and fine granules; abdomen a little more densely granulate. Anal sternite not projecting beyond the narrow underside of elytral apex; basal sternite in the ♂ with the middle of apical half slightly raised and there bearing a patch of conglomerated, dense, bare and somewhat abraded granules. Bristles of tibial edges testaceous. Basal joint of posterior tarsi distinctly longer than ungual joint.

Dimensions: Length 8 to 9 1/2 mm., width 4 3/4 to 6 1/2 mm., height 2 1/2 to 2 3/4 mm.

**Locality:** Cape Province, Great Karroo: Willowmore, 30 October 1948, leg. University California-Transvaal Museum Expedition (4 ♂♂, 3 ♀♀, holo- and allotype in T.M., paratypes in T.M., C.A.Sc., and BCM.); same locality, April 1913, leg. H. Brauns (2 ♂♂, paratypes in T.M.).

**Habitat:** On sandy soil under plants and stones.

**Systematic position:** This species comes closest to *L. denticollis* Haag, agreeing with the latter in the formation of head, build and sculpture of body, and in the elongate third antennal joint; but it is distinguished in the lack of the median carinula on head, the deeper lateral emarginations of pronotal base, and the dimorphism as to the shape of elytra. In the ♀ of *denticollis* the elytra are as much broadly rounded as in the ♂ of the new species.

I was able to examine the ♂ holotype and ♀ allotype of *denticollis* (ex Z.St.S.).

***Lycanthropa Pienaari* n. sp.**

(Plate IV, fig. 122)

It is another new species of the *denticollis*-group, closely related only to *L. dimorpha*, from which it is distinguished in the following particulars.

Body larger, 8 1/2 to 11 mm. long, 6 to 7 1/2 mm. wide, and 2 1/4 to 3 mm. high.

Upper surface without long hairs, evenly covered with short and erect bristles; cilia on sides much shorter than those in *dimorpha*.

Lateral edge of pronotum and elytra with regular, very dense and fine denticulation; irregular, much coarser and more scattered in *dimorpha*.

Base of pronotum almost straight, hardly sinuate in front of posterior angles; the latter obtusely rounded; median impression narrower and closed behind, only as broad as the basal convexity of pronotum (in *dimorpha* almost open behind and much broader than the obsolete basal convexity of pronotum).

Elytra not punctured, but densely covered by a very fine microgranulation, which is intermixed with sharp, somewhat strobiliform, coarse secondary granules; submarginal depression broad, foliaceous, extending to one-fifth the width of each elytron; reflected portion granulate, with the outer portion broadly depressed and foliaceous.

Depressed portion of mesosternum with an extremely fine, scarcely perceptible, hair-like carinula basally (without such a carinula in *dimorpha*).

Basal surface of prothorax, in sectional view, without any prominent structure (in *dimorpha* there is a minutely prominent angle at the inner edge of complanate lateral surfaces, each side of foramen).

Antennae a little slenderer, with the third joint more elongate and about as long as the three following joints combined.



♂ without distinctive characters on basal sternite of abdomen; the elytra of the ♀ only a little longer than those of ♂.

Locality: Cape Province, Laingsburg district: top of Zwartberg, near Avondrust, July 1950, leg. E.A. Pienaar (14 spec., holo- and allotype in T.M., paratypes in T.M. and B.C.M.).

I have dedicated this new species to Mr. E.A. Pienaar, who kindly presented the Transvaal Museum with a fine collection of several most interesting new species of Tenebrionidae, he collected on the summits of the Zwartberg-Mountains.

***Lycanthropa plana litoralis* subsp. n.**

(Plate IV, fig. 123)

This new form, no doubt close to *plana* Haag, is chiefly characterized in the straight lateral portions of pronotal base (distinctly sinuate and emarginate in the holotype of *plana*), the more convex and dull elytra, the lateral margin of which is differently shaped. The submarginal depression along the lateral edge is very narrow; viewed from behind, the discal convexity seems to be almost in contact with the lateral edge, whereas it is well separated from the latter by a comparatively broad submarginal depression in the holotype of *plana*.

The depressed portion of mesosternum is distinctly carinate along midline at the base. The inner edge of the complanate lateral surfaces of prothorax, examined in sectional view, is sharply angulate, almost dentiform.

Locality: Western Cape Province: Elands Bay, 8 November 1948, leg. University California-Transvaal Museum Expedition (21 spec., holo- and allotype in T.M., paratypes in T.M., C.A.Sc. and B.C.M.).

From the typical *plana* Haag, I have seen only the single holotype (ex Z.St.S.).

***Eurychora Forsteri* n. sp.**

(Plate IV, fig. 130)

Black, the foliaceous parts of pronotum brownish; shiny; with black pilosity. Head above with sparse granules, and a sharp and straight carina at midline of the frontal-epistomal surface. Supra-antennal portions strongly raised, with almost straightly narrowed lateral outlines; viewed from above, the genal-epistomal contours conceal those parts of the head, which are lateral in position. Supra-orbital ridges strongly developed and prolonged backwards. Middle of epistomal emargination with two obsolete and blunt teeth. Anterior margin of submentum carinate. Underside of head covered with a very scattered granulation, except for the densely granulate buccal fissure lobes. The apical margin of the latter obliquely truncate. Antennae

elongate; third joint about as long as the two following joints taken together; the intermediate joints longer than broad; eighth joint square, ninth one slightly transverse, and the apical joint a little broader than the penultimate joint, and only a little longer than that. Pronotum almost four times as broad as long, broadest in front of posterior angles, sparsely and finely granulate on lateral portions, obsoletely punctured on discal convexities in front and behind median impression. Base of anterior emargination straight, furnished with a dense fringe of yellowish hairs, and about as long as the inner lateral margin. Sides strongly rounded and strongly narrowed towards anterior angles, slightly narrowed towards the subrectangular posterior angles, irregularly denticulate and bearing a fringe of blackish brown, erect and moderately long cilia. Base almost straight, furnished with a fringe of yellowish bristles, becoming dark and shorter towards sides. Disc across middle with a broad and complete transverse impression. Lateral surfaces strongly raised and covered with sparse, short and erect bristles of a blackish tint. Prosternum moderately shiny, with very fine setiferous granulation and uneven background. Elytra strongly rounded, broadest at middle, there as broad as pronotum or narrower, and about as broad as long, flat, except for the slight and gradual basal declivity. Base arcuate, with broadly rounded shoulders and distinctly raised humeral portion. Sides strongly rounded and narrowed towards humeral portion; the lateral edge well developed, bent upwards, subgranulate and furnished with a fringe of moderately long, erect bristles of a blackish brown colour. Apex broadly rounded, not caudate. Integument evenly covered with very fine and rather sparse, minute granules, from which emerge short and erect black bristles of equal length; background of cuticula irregularly and slightly wrinkled. Reflected portion broad, at level with metasternum, and a little broader than the latter, shiny, bare, with a few very fine granules; the lateral portion with a row of transverse tubercles along lateral edge. Metasternum shiny at middle; abdomen uniformly covered with rather sparse and fine granules, from which merge very short, semi-erect black bristles. Apex of anal sternite a little projecting beyond elytral apex. Bristles of tibial edges black. Basal joint of posterior tarsi distinctly shorter than ungual joint.

Dimensions: Length  $14 \frac{1}{2}$  to 15 mm., width 9 to  $9 \frac{1}{2}$  mm., height 4 to  $4 \frac{1}{2}$  mm.

Locality: Unknown; 2 specimens, holotype, sex not determined, in Z.St.S., paratype in T.M.

I name the new species in honour of Dr. W. Forster, chief of the entomological section of the Zoologische Staats-Sammlung at München.

Systematic position: From the hitherto known species having a black pilosity of body the new species differs by the completely flat disc of

elytra, which is strongly convex in all the other species of this group, except for *Eu. terrulenta* Haag. From the latter it is distinguished by the abbreviate third joint of antennae, which is only as long as the two following joints taken together, whilst it is as long as the three following joints combined in *terrulenta*.

*Eu. planata* Haag too has a flattened disc of elytra, but it is quite different from the new species in the narrower build of body, the yellowish pilosity, the thickly tomentose discal portions of sterna, and the broad antennae.

The correct systematic position of *Eu. Forsteri* appears to be near to *Eu. tumidula* Haag and *Eu. luctuosa* Haag, as *Forsteri* agrees with both species in the structure of the reflected and subgranulate lateral edge of elytra, the presence of a median carina on head, and the length and structure of antennae, differing from them in the completely plane and flat disc of elytra and the intensely black pilosity of body. As both related species come from the Western Cape Province, I suppose the locality of the new species to be likewise in the western parts of the Cape Province.

**Eurychora kaokoveldea n. sp.**

(Plate IV, fig. 127)

Black; shiny; pilosity of body reddish yellow. Head above covered with rather dense granules, becoming scattered on inter-ocular space. Supra-antennal portions slightly raised, with the lateral contours, viewed from above, strongly sinuate and leaving a small part of those portions of head exposed, which are lateral in position. Supra-orbital ridges strongly developed, subangular above eyes, and prolonged backwards. Median teeth of epistomal emargination short. Antennae elongate, very little incrassate towards apex; third joint about as long as the two following joints combined; the latter longer than broad; penultimate joint very little broader than long; apical joint one and a half times as long as the previous one. Pronotum broadest between posterior angles, there a little less than four times as broad as long, with a few very fine granules. Base of anterior emargination distinctly longer than inner lateral margin, furnished with a fringe of dense and long yellowish hairs. Sides strongly rounded, but hardly narrowed in front of posterior angles; the latter rectangularly rounded. Lateral edge obsoletely crenulate and not denticulate, covered with yellowish hairs, as on base. The latter with the middle produced into a broad, apically subtruncate lobe, with oblique and slightly sinuate sides, and with the posterior angles situated at a level, which is more cephalad than that of median lobe. Middle of disc with a complete and rather narrow transverse impression, and with a rather broad and strong median convexity in front of the latter. Lateral

portions slightly raised above level of the median convexity of disc, sparsely granulate, covered with short and erect yellowish bristles, and with obsoletely punctured background of cuticula. Prosternum sparsely granulate, convex, with a deep transverse impression in front of apophysis; apical declivity of the latter furnished with a brush of whitish yellow hairs; episternum sparsely granulate, with the background covered with some very dense and coarse, almost foveate, but shallow punctures. Elytra broadest at middle, there distinctly a little longer than broad, and about as broad as pronotum, strongly convex, shiny. Base straight only in front of mesothoracic tergite, with the sides strongly and obliquely sloping towards the broadly rounded, obtuse shoulders; ciliate. The open space between posterior angles of pronotum and humeral portion of elytra is very broad, on account of the strongly produced median portions of the elytral base, as well as pronotal one. Sides strongly rounded, a little narrowed towards humeral angles, furnished with a fringe of yellowish cilia. Apex obtuse. Convexity very strong; in caudal view, with the contours forming a regular, arcuate line, which is in direct contact with the lateral edge; examined from the side, the highest point is to be found before middle. The integument consists of a fine and scattered punctuation, which is setiferous only on the sloping basal and apical portions. Reflected portion at level with metasternum, about as broad as metathorax, with a few extremely fine granules. Discal portion of metasternum raised, rather densely covered with sharp granules, with the lateral parts together with episternum strongly sloping towards elytral border. Abdomen shiny, evenly covered with sharp and sparse granules, and with sparse, adherent yellowish bristles; anal sternite more densely granulate and pilose, hardly projecting beyond elytral apex. Bristles of tibial edges of a reddish yellow tint. Basal joint of posterior tarsi considerably shorter than ungual joint.

Dimensions: Length 13 mm., width 7 1/2 mm., height 5 mm.

Locality: South West Africa, Kaokoveld: Franzfontein, 16 May 1948, leg. University California-Transvaal Museum Expedition (1 single holotype, sex not determined, in T.M.).

Systematic position: The new species belongs to a South West African and Angolan group of *Eurychora*, in which the background of the cuticula on episternum of prosternum is coarsely and densely punctured. From the study of the holotypes (ex Z.St.S.) of the three species, Haag has placed to this group, follows that *Eu. punctipennis* Haag is not a true *Eurychora* but a *Serrichora*. From the two remaining species of this group *kaokoveldica* differs: from *angolensis* Haag in the strongly rounded and obliquely sloping shoulders (which are well pronounced, obtuse to rectangular in *angolensis*), the strongly convex elytra (which in *angolensis* are only



slightly convex and have considerably reflected lateral and humeral edges), the narrow transverse impression across pronotal disc (which in *angolensis* is roundish and much broader than the slightly convex anterior portion of disc), the very sparsely granulate reflected portion of elytra (which in *angolensis* is densely and coarsely punctured, and characterized by a depressed and transversely wrinkled submarginal area), the much longer and denser hairs on sides of body, and the abbreviate basal joint of posterior tarsi (which is as long as the ungual joint in *angolensis*); from *villosa* Haag, to which the new species comes nearest, in the lack of the extremely long and fine lateral ciliation and dorsal pilosity of elytra, which is peculiar to *villosa*, the more sparsely granulate and less pilose abdomen, the bare mesosternal apophysis (furnished with long erect hairs in *villosa*), the only pubescent apical declivity of prosternal apophysis (densely tomentose in *villosa*), the very sparsely granulate inter-ocular space of vertex (as in *angolensis* rather densely granulate in *villosa*).

As to the shape and convexity of elytra, the proportions of the joints of posterior tarsi, and the shape and sculpture of the reflected portion of elytra, the new species agrees well with *villosa*.

*Eu. villosa* seems to be confined to Damaraland and the northern part of Great Namaqualand; the specimens from northern Bechuanaland, Hesse, 1935, has referred to this species, appear to be identical with *Eu. trichoptera* Gerst.

***Eurychora ovamboana* n. sp.**

(Plate IV, fig. 131)

Black; moderately shiny or almost dull; pilose. Head above densely granulate, with the granules becoming scattered on inter-ocular space: covered with short, fine and adherent yellowish bristles. Frontal-epistomal surface with a fine and straight median carinula. Epistomal emargination with two very small teeth at middle. Supra-antennal portions strongly raised, with the lateral contours strongly sinuate and leaving exposed a comparatively large portion of the sides of head. Supra-orbital edges straightly prolonged backwards. Inter-ocular space concave. Underside covered with rather dense and fine sharp granules, and short adherent yellowish bristles. Antennae stout, gradually accrescent towards apex; third joint only a little longer than basal joint, about twice as long as broad, and about as long as the two following joints taken together; fourth joint square; the following joints slightly to strongly transverse; the penultimate joint about one and a half times as broad as long; apical joint hardly broader than penultimate joint, but one and a half times as long as that. Pronotum broadest in front of posterior angles, there three and a half times as broad as long,

covered with fine and sparse granules on disc, becoming coarser and more concentrated on lateral portions. Base of anterior emargination about one-third longer than inner lateral margin, furnished with a fringe of long and dense yellowish hairs. Sides strongly rounded and dilated towards base, slightly narrowed in front of posterior angles; lateral edge irregularly and obsoletely denticulate, with rather long yellowish cilia. Base straight, distinctly sinuate near to posterior angles, furnished with a fringe of yellowish bristles. Posterior angles slightly produced backwards. Middle of disc with rather broad transverse impression; lateral portions slightly raised above level of anterior convexity of disc. The integument covered with comparatively dense and fine granules on disc, bearing rather long and adherent fine hairs of a whitish yellow colour, which become erect and stiffer on lateral portions. Prosternum densely covered with sharp granules and semi-erect short bristles on disc, becoming scattered on lateral portions; episternum sparsely granulate and with a few fine and almost adherent bristles, and with the background between granules uneven and obsoletely punctured; apical declivity of apophysis hairy. Elytra about as broad as pronotum, hardly longer than broad, covered with an obsolete and shallow fine punctation, which is intermixed with fine granules and erect hairs. Base ciliate, slightly arcuate, with almost rectangular, strongly developed and faintly raised humeral angles. Sides hardly narrowed towards humeral angles, almost subparallel in front of middle: strongly rounded and narrowed towards the slightly caudate apex. Lateral edge subgranulate and furnished with long and erect yellowish cilia. The sculpture of integument bears a duplicate pilosity: short and erect bristles of a yellowish brown tint on background, and three to four longitudinal rows of long and fine yellowish hairs on each elytron, with the outer rows situated close to the ciliate lateral edge; very close to the latter runs a longitudinal row of coarse granules. Convexity moderate and in contact with lateral edge; viewed from the side, the highest point is situated at about middle of elytra; basal declivity short, but rather steep. Reflected portion shallowly punctured and densely granulate, at level with the metasternum, and narrower than metathorax. Underside of afterbody rather densely and sharply granulate, covered with a uniform and comparatively long, nearly adherent yellowish pilosity; anal sternite not prolonged beyond apex of elytra. Bristles of tibial edges yellowish to reddish yellow. Basal joint of posterior tarsi a little shorter than ungual one.

**Dimensions:** Length  $11 \frac{1}{2}$  to  $14 \frac{3}{4}$  mm., width  $7 \frac{1}{4}$  to  $9 \frac{1}{2}$  mm., height  $3 \frac{3}{4}$  to 5 mm.

**Localities:** South West Africa, Ovamboland: Oshikango, July 1948, leg. University California-Transvaal Museum Expedition (5 spec., holo- and allotype in T.M., paratypes in C.A.Sc. and B.C.M.). Southern Angola: Nau-

lila, 8 July 1948, leg. University California-Transvaal Museum Expedition (1 paratype, T.M.).

**Systematic position:** The new species is well characterized by the broad and flattened, *Pogonobasis*-like body, recalling the East African *Steptochora setulosa* (Fairm.). Apart from the generic characters, it agrees with this species in the almost rectangular humeral angles, the basally only a little narrowed elytra, the very small open space between base of pronotum and that of elytra, and the pilose disc of pronotum; it differs, however, considerably in the broader shape of body, the densely granulate and pilose, dull elytra (which in *setulosa* are shiny and covered with an extremely fine and very scattered punctation), the deeply sinuate genal-epistomal contours of head (straight in *setulosa*), and the distinct punctation of the background of cuticula on episternum of prosternum.

From the *Eurychora* having a punctured episternum of prosternum the new species is easily distinguished: from *angolensis* Haag by the not reflected lateral edge of elytra, from *villosa* Haag by the lack of the long pilosity on elytra, and from *kaokoveldae* n. by the almost straight base of elytra and the quite different shape and convexity of the latter.

From a form of *Eu. nitida* Haag, with which it occurs together at the same localities, *Eu. ovamboana* differs in the almost rectangular humeral angles of elytra (obtusely rounded in the South-Angolan *nitida*), the comparatively dense granulation of elytra (very sparse in the *nitida* from Southern Angola), the much less convex elytra, and the sharp median carina on head.

I do not know *Eu. rotundipennis* Fairm., from Ovamboland; according to the description, this species seems to be distinguishable from the new one in the strongly rounded elytra and the elongate third joint of antennae, which is indicated to be almost as long as the three following joints taken together.

#### ***Eurychora reflexa* n. sp.**

(Plate IV, figs. 128, 129)

Black, densely covered with a waxy secretion and earthy particles; dull; pilose. Head above with sparse granular rugosities, from which emerge some yellow adherent bristles. Epistomal emargination without distinct median teeth. Supra-antennal portions strongly raised, with the lateral contours, viewed from above, distinctly sinuate and leaving exposed a small portion of the sides of head. Supra-orbital edges slightly arcuate and prolonged backwards. Submentum with a transverse row of sharp granules anteriorly. Under-side of head covered with sparse and fine setiferous granules. Antennae elongate; third joint a little longer than the two following joints combined, strongly narrowed towards base, and about three times as long as broad; the following joints longer than broad, very little accrescent towards apex; eighth

joint about as long as broad; penultimate joint hardly broader than long; apical joint one-third broader and not quite two-thirds longer than the previous joint. Pronotum broadest between posterior angles, there about four times as broad as long, covered with only a few very fine granules and some short and erect yellowish bristles. Base of anterior emargination narrow, about one-third shorter than inner lateral margin, furnished with a fringe of yellowish bristles. Anterior angles strongly produced, enclosing the head up to genal angles. Sides strongly dilated towards base, but only slightly rounded, with the lateral edge irregularly denticulate or crenulate, and furnished with short yellowish bristles. Posterior angles obtusely rectangular. Base distinctly sinuate near to posterior angles, with the middle produced backwards and there with a fringe of short yellowish bristles. Middle of disc with a rather shallow and complete transverse impression and with a slight convexity in front of the latter. Lateral portions strongly raised above level of disc. Underside with very fine and scattered setiferous granules; prosternum across middle with transverse impression; the perpendicular apical declivity of apophysis with some short and erect bristles. Elytra as broad as pronotum or a little broader, roundish, and about as broad as long, or a little broader. Sides very slightly narrowed towards the broadly rounded humeral portions, more strongly rounded and gradually narrowed towards apex. Lateral edge broadly bent upwards, the humeral portion and apex included, rather sharp and bearing a fringe of dense, yellowish short cilia. Apex broadly truncate, often without distinct hiatus at suture. Base almost straight. Convexity very strong, but confined to the sutural portion; viewed from behind, the contours show a strongly arcuate line at middle, becoming gradually concave towards sides and again raised upwards along lateral edge; in lateral aspect the contours are almost straight at middle, with a rather steep declivity towards base, as well as apex. Integument covered with sparse and fine granules, from which emerge short and erect bristles, becoming longer and very dense on the raised sutural portion on disc. Reflected portion very broad, at level with the metasternum, distinctly broader than metathorax, broadly flattened apically, and completely enclosing the apex of elytra; covered with very fine and sparse setiferous granules. Abdomen narrow, rather densely covered with granules, which bear short and erect yellowish bristles on disc of the three first sternites; anal sternite enclosed by the apically almost coalescent and broad apex of the reflected portions of elytra, only one and a half times as long as the latter. Tibiae with the bristles on edges of a yellowish to brown colour, those on surfaces whitish yellow. Basal joint of posterior tarsi distinctly shorter than ungual joint.

Dimensions: Length 11 1/2 to 17 1/2 mm., width 9 to 13 mm., height 4 1/2 to 5 1/4 mm.



**Localities :** Northern Little Namaqualand : Port Nolloth, May 1922, leg. Bell-Marley (1 specimen, sex not determined, in T.M.); 15 miles East of Port Nolloth, 16 November 1949, leg. C. Koch (1 paratype in T.M.); Ooograbies, 30 August 1950, leg. C. Koch and G. van Son (18 paratypes in T.M. and B.C.M.); O'Okiep, leg. Péringuey (1 paratype in Z.St.S.); 15 miles West of Garies, 15 November 1948, leg. University California-Transvaal Museum Expedition (1 paratype C.A.Sc.).

**Habitat :** Nocturnal Tenebrionid, after sunset coming out from holes of mammals and lizards, and under shrubs.

**Systematic position :** The new species, resembling a large *Lycanthropa*, differs from all the other *Eurychora* by the broad and strongly reflected submarginal area of elytra, which is strongly projecting beyond apex of abdomen apically. Owing to the pilose and strongly raised sutural portion of elytra, it comes near only to *Eu. suturalis* Haag, from which, however, it is easily distinguished by the almost bare sterna, which lack the thick and lanuginous pilosity, peculiar to *suturalis*; the strongly raised humeral and apical portions of elytra, with the subtruncate apex being bent upwards and projecting much beyond anal sternite of abdomen (obtusely acuminate, almost flat and only a little projecting beyond anal sternite in *suturalis*); and the sinuate lateral portions of pronotal base, forming sharp and prominent posterior angles.

Both species seem to occur in the same regions, as I know *Eu. suturalis* from the Buffels River near Grootmist, Hondeklip Bay, and Garies, which localities are all situated in Little Namaqualand.

The holotype of the new species originally has been classified as *Eu. tumidula*, probably owing to its broadly truncate apex of elytra. But *tumidula* Haag, according to the examen of the holotype (ex Z.St.S.) is a species from the Western Cape Province and Little Namaqualand, which is closely allied to *Eu. ciliata* F. (sensu Haag, 1872); it is easily separated from the new *reflexa* in the broad abdomen and the quite different build of elytra; the latter have a subgranulate and not reflected lateral edge, their discal convexity is very strong and shows the characteristic contours, as in all the other allies of *ciliata*, their apex is broadly rounded, but not truncate, and not projecting beyond abdominal apex, and finally they lack the strongly raised and pilose sutural portion, which is peculiar among all *Eurychora* only to *suturalis* and the new species.

The numerous forms of the *tumidula-luctuosa-major-ciliata*-group have still to be thoroughly studied, but they agree all very well in the characteristic strong median convexity and the simple lateral edge of elytra, which is never bent upwards.

**Serrichora Fahraei Lilieri subsp. n.**

The new form is most similar to *S. Fahraei*, from which it is distinguished in the smaller size (7 to 8 mm. long) and in the abbreviate third joint of antennae. The latter is one and a half times as long as the fourth joint, much shorter than the two following joints combined, and distinctly shorter than the basal joint. In typical *Fahraei*, coming from Northern Transvaal, Southern Rhodesia and Bechuanaland, the third joint of antennae is elongate, about twice as long as the fourth joint, approximately as long as the two following joints taken together, and distinctly longer than the basal joint. There is, however, a certain variability as to the length of the third antennal joint in the typical *Fahraei*, for in specimens from Northern Bechuanaland the antennae are more elongate than, f.i., in those from the Kruger National Park; but never the antennae become as much abbreviate and incrassate as in *Lilieri*, which I take provisionally to be a vicariant subspecies to *Fahraei*. The size of the typical *Fahraei* varies from 7 3/4 to 11 mm. in length.

Locality: Zululand: Hluhluwe Reserve, April 1950, leg. K. Th. Lilier (9 specimens, holo- and allotype, paratypes in T.M. and B.C.M.).

Habitat: Collected under the bark of dead trees and trunks. I have named this new form after its discoverer, Mr. R. Th. Lilier, Pretoria.

**Serrichora Fahraei Corintae subsp. n.**

The new form differs constantly from the typical *Fahraei* and the subsp. *Lilieri* in the reduced sculpture on reflected portions of elytra. In *Fahraei* f.t. and *Lilieri* this part of body is always densely and coarsely punctured, showing fine granules on the intervals between punctures; in the new subspecies there are only the fine granules developed, whilst the punctation is altogether absent, or reduced to very obsolete traces.

In the formation of antennae the new subspecies agrees with the typical *Fahraei*.

Locality: Portuguese East Africa: Ponta Vermelha, Lourenço Marques, February 1950, leg. M.C. Ferreira (3 spec., holotype, sex not determined, in M.A.C., paratypes in T.M.).

Named in honour of Dr. Maria Corinta da Veiga Ferreira, entomologist to the Museu Dr. Alvaro de Castro at Lourenço Marques.

**Serrichora Bossmani n. sp.**

(Plate V, fig. 135)

Reddish brown to blackish brown, the middle of upper surface of head black; strongly shiny; pilose. Head above densely and rugosely reticulate; with the inter-ocular space slightly concave at middle, smooth and covered

with only a few round granules. Middle of epistomal emargination with two sharp teeth. Supra-antennal portions slightly raised, with straight and sub-parallel lateral contours, which are separated from lateral outlines of epistome by a minute sinuosity. Anterior half of head with a sharply raised and straight median carina. Supra-orbital ridges fine, a little prolonged backwards and extending forwards beyond inner margin of eye. Underside as in *Langi* n. Antennae short, strongly incrassate towards apex and complanate; third joint two and a half times as long as broad, strongly narrowed towards base, only a little shorter than the three following joints combined; fourth joint square; the following joints transverse, becoming much broader towards apex, with the penultimate joint twice as broad as long; apical joint a little shorter than the two previous joints taken together. Pronotum broadest in front of base, three and a half times as broad as long, sparsely granulate, and in the lateral impressions with some coarse and shallow punctures. Base of anterior emargination one and a half times as long as inner lateral margin. Sides strongly rounded and dilated towards the broadest point of pronotum, thence slightly narrowed in front of the obtuse posterior angles. Lateral edge strongly and sparsely, sharply denticulate. Disc across middle with a broad and deep transverse impression. The foliaceous lateral portions slightly raised, with a broad and round, rather deep impression at middle. Base almost straight, furnished with a fringe of short testaceous bristles. Underside rather densely granulate; apophysis bent downwards. Elytra broad, only a little longer than broad, about as broad as pronotum, convex, caudate, with the lateral edge strongly and sharply denticulate. Base slightly arcuate, with sharp, almost rectangular humeral angles, furnished with a fringe of sparse and long hairs; humeral angles distinctly bent upwards. Sides rounded, faintly narrowed towards base. Dorsal convexity separated from lateral edge by a depressed submarginal area, strongly sloping towards the base at middle. Integument covered with a duplicate punctation: with scattered coarse punctures, and in between with very fine ones. Pilosity, as on pronotum, covered with fine and erect, rather long hairs. Reflected portion coarsely and densely punctured, with the intervals between punctures covered with a few very fine granules. Punctuation on abdomen comparatively dense. Bristles of tibial edges reddish. Basal joint of posterior tarsi about as long as ungual joint, or a little longer.

Dimensions: Length  $6\frac{1}{2}$  to  $7\frac{1}{2}$  mm., width  $4\frac{1}{4}$  to  $4\frac{1}{2}$  mm., height 2 to  $2\frac{1}{4}$  mm.

Locality: Southern Cape Province, Great Karroo: Willowmore, 15 August 1921, leg. H. Brauns (6 spec., holo- and allotype in T.M., paratypes in T.M. and B.C.M.); a further specimen without locality in Z.St.S.

It is a pleasure for me to name this new species in honour of Mr. E.A.A. Bossmann, General Manager of South Africa's Shell Company, as acknowledgment of the many facilities received during the University of California-Transvaal Museum Expedition.

**Systematic position:** *S. Bossmanni* is closely related to *S. crenata* (Sol.), sensu Haag; it is distinguished by the much broader and shorter body, the strongly rounded sides of the short and more convex elytra, which are decidedly caudate apically, and very sparsely punctured, the strong denticulation of the lateral edges of pronotum and elytra, the almost straight base of pronotum (which is deeply bisinuate in *crenata*), and the slenderer extremities.

*S. crenata* is known to me from the Albany district, Grahamstown, Port Elizabeth and Algoa Bay.

***Serrichora similis zulu* subsp. n.**

Constantly differing from the typical *similis* (Haag) as follows. Head without median carina (in *similis* f.t. the median carinula is constantly developed); sculpture of the inter-ocular space on head resolved into separated granules (in *similis* f.t. with irregular and confluent reticulation); submarginal depression of elytra comparatively broad, with the discal convexity, viewed from behind, being separated from lateral edge by a horizontally flattened submarginal area (in *similis* f.t. the discal convexity is almost in touch with the lateral edge); antennal joints five to ten strongly transverse and more dilated towards apex, with the third joint slenderer and a little longer than the two following joints combined (in *similis* f.t. the antennae are less incrassate towards apex, with square fifth joint, only slightly transverse sixth one, and with the third joint about as long as the two following joints combined); body broader, with the elytra a little shorter and more rounded.

**Localities:** Zululand: Hluhluwe Reserve, April 1950, leg. C. Koch and K. Th. Lillier (24 spec., holo- and allotype in T.M., paratypes in T.M. and B.C.M.); Empangeni, August 1928, leg. A.G. White (1 paratype, T.M.).

**Habitat:** On sandy soil under stones.

The typical *similis* occurs in Transvaal. Material from the following localities has been compared with the holotype (ex Z.St.S.): Pretoria district, 20 to 24 November 1908, leg. C. Swierstra (2 spec., T.M.); Louwscreek, March 1920, leg. G. van Dam and A. Roberts (2 spec., T.M.); Waterval, 22 November 1899, leg. A.J.T. Janse (1 spec., T.M.); Elands River, Middeburg district, 1 to 10 March 1924, leg. A. Roberts (1 spec., T.M.).



**Serrichora karrooensis n. sp.**

(Plate V, fig. 134)

Blackish brown to black, towards sides reddish. Head above densely covered with more or less longitudinal rugosities, except on inter-ocular space, which is subsulcate along midline, about three times as broad as the longitudinal diameter of eyes, smoothed and bearing only a few fine and round granules. Middle of anterior portion of head with a very fine, elevate and straight carinula. Epistomal emargination with two obsolete teeth at middle. Supra-antennal portion slightly raised, with the lateral contours, viewed from above, straight and almost subparallel, forming a very weak obtuse angle with the slightly convergent lateral outlines of epistome. Supra-orbital edges confined to inner margin of eyes. Underside as in *Langi* n. Antennae moderately long, strongly accrescent towards apex, compressed; third joint very elongate, about three times as long as broad, strongly narrowed towards base, and about the length of the three following joints together; fourth and fifth joints distinctly longer than broad; sixth joint square to slightly transverse; the following joints becoming gradually broader towards apex, with the penultimate joint one and a half times as broad as long; apical joint a little shorter than the two previous joints combined. Pronotum broadest near to base, there three and a half times as broad as long, sparsely covered with fine granules and rather dense, fine and short erect hairs. Base of anterior emargination two-thirds longer than inner lateral margin. Anterior angles strongly produced and enclosing the head up to genal angles. Sides rounded and strongly dilated towards the broadest point, thence slightly narrowed in front of posterior angles; the latter slightly obtuse. Base almost straight, furnished with a fringe of dense yellowish bristles, becoming scattered or absent towards middle. Disc across middle with a rather deep and broad transverse impression in front of base; anterior convexity strong. The foliaceous lateral portions slightly raised, impressed at middle. Lateral edge with very fine and regular denticulation, becoming sometimes stronger and less dense at posterior half. Prosternum covered with a dense granulation discally and on apophysis; episternum with fine and sparse granules; apophysis perpendicularly declivous, with yellowish pubescence apically. Elytra narrower than pronotum or as broad as that, strongly convex, only a little longer than broad, with duplicate punctation, and covered with dense, long and erect yellowish bristles. Lateral edge strongly denticulate, except for the caudate apical lobe, the sides of which show a fine denticulation. Sides strongly rounded, distinctly narrowed towards the rather sharp and slightly obtuse humeral angles, strongly narrowed towards apex. Base furnished with a fringe of scattered and long yellowish hairs, broadly produced forwards at middle, with the sides obliquely sloping

towards humeral angles. Discal convexity moderate, in contact with lateral edge, strongly sloping towards base, less so towards apex. Integument covered with sparse and coarse, subfoveate primary punctures; the intervals between those punctures uneven and showing a fine setiferous secondary punctation. Reflected portion with rather dense and coarse punctation, with the intervals between punctures covered with scattered fine granules. Epipleural carina of apex prolonged and on both sides flanked by a row of coarse punctures. Abdomen densely granulate. Bristles of tibial edges yellow to reddish. Basal joint of posterior tarsi almost as long as both the distal joints combined.

Dimensions: Length 8 to 9  $\frac{3}{4}$  mm., width 4  $\frac{1}{2}$  to 5  $\frac{1}{2}$  mm., height 2  $\frac{3}{4}$  to 3  $\frac{1}{4}$  mm.

Locality: Southern Cape Province, Great Karroo: gorge 8 miles West of Willowmore, 1 November 1948, leg. Univ. California-Transvaal Museum Expedition (3 spec., holo- and allotype in T.M., paratype in C.A.Sc.).

Standing near to *S. similis* (Haag), the new species is distinguished from the latter in the broader and shorter shape of body; the elongate third joint of antennae, which is as long as the three following joints together (whereas it is as long as the two following joints together, in *similis*); the smooth inter-ocular space on vertex, bearing only a few very fine granules (densely and rugosely reticulate in *similis*); and the elongate basal joint of posterior tarsi (which is as long as the ungual one, in *similis*).

From the following new species, *longantennata* n., *S. karrooensis* is distinguishable by the median carinula on head and the different proportions of antennal joints.

***Serrichora longantennata* n. sp.**

(Plate V, fig. 136)

Blackish brown, becoming reddish brown towards sides, the appendages reddish brown; shiny; pilose. Head above densely covered with longitudinal rugosities, except for the inter-ocular space, which is slightly concave along midline and sparsely granulate. Epistomal emargination with two short median teeth. Supra-antennal portions slightly raised and separated from the lateral outlines of epistome by a well pronounced sinuosity, forming with the contours of genae an obtuse angle. Pre-ocular impressions large. Supra-orbital edges confined to inner margin of eyes, only obsoletely produced and converging towards middle of vertex. Underside as in *Langi* n. Antennae comparatively much elongate, acerescent and compressed; the single joints of similar proportions as in *Langi* n., except for the penultimate joint, which is longer than the previous joint and only a little broader than long.

Pronotum as in *Langi* n., but the base straight, hardly emarginate at middle, with coarser and deeper punctures in lateral impressions. Underside as in *Langi* n. Elytra as in *Langi* n., but the lateral edge sharply denticulate, as in all the other *Serrichora*, without submarginal depression, with more pronounced rectangular humeral angles, hardly broader than pronotum and more densely covered with erect hairs. Punctuation on reflected portions denser, with the punctures more or less arranged in longitudinal rows; punctuation on abdomen more scattered. Basal joint of posterior tarsi considerably longer than ungual joint, almost the length of the two distal joints taken together.

Dimensions: Length  $7 \frac{3}{4}$  to 9 mm., width 5 to  $5 \frac{1}{2}$  mm., height  $2 \frac{1}{4}$  to 3 mm.

Locality: Northern Transvaal: Queensdale near Wylespoort, 1 August 1949, leg. C. Koch and G. van Son (3 spec., holo- and allotype, paratype in T.M.).

*S. longantennata* is another new species of the *similis*-group, from whose species it is easily distinguished by the long antennae, with all joints being longer than broad, except for the penultimate one, which appears to be slightly transverse. Owing to the broadly rounded shape of body and the elongate antennae it is related to the following new species, *S. Langi*, from which it is immediately recognized by the sharply serrate-dentate lateral edge of elytra (smooth in *Langi* n.), the strongly sinuate genal-epistomal contours (straight in *Langi*), and the elongate basal joint of posterior tarsi.

#### ***Serrichora Langi* n. sp.**

(Plate V, fig. 138)

Brownish black, towards sides reddish brown. Head above evenly covered with a very dense, rugose and elevate reticulation. Lateral contours of supra-antennal portions almost straightly narrowed towards the rounded lateral portions of epistome, forming an obtuse angle with the genal outlines. The two median teeth of epistomal emargination well developed. Pre-ocular impressions deep and larger than eyes. Inter-ocular space flat, about twice as broad as the longitudinal diameter of eyes. Supra-orbital edges short, confined to inner margin of eyes. Submentum and buccal fissure lobes very densely rugose; the latter with obliquely truncate apical margin. Submentum without transverse crest apically. Apical joint of maxillary palpi very slender, cylindrical, about three times as long as broad. Antennae long, strongly accrescent towards apex, compressed; third joint much elongate, three and a half times as long as broad, much longer than basal joint, and distinctly longer than the two following joints taken together; fourth joint a little shorter than half the length of the third one, and distinctly

longer than broad; fifth joint longer than broad; sixth joint about as long as broad; the following three joints becoming gradually broader towards apex; penultimate joint one and a half times as broad as long; apical joint a little shorter than the two previous joints combined, about as long as basal joint. Pronotum broadest in front of posterior angles, there a little less than three times as broad as long, covered with a few fine granules. Base of anterior emargination two-thirds longer than inner lateral margin. Anterior angles strongly produced, enclosing the head up to genal angles, rounded. Sides rounded and strongly dilated towards base; lateral edge with extremely fine and dense, minute denticulation. Base with broad emargination at middle, furnished with a fringe of testaceous and very short bristles, which usually are rubbed off at middle. Disc with broad and deep transverse impression across middle, and with strongly raised anterior convexity in front of impression. Lateral portions foliaceous, with a broad and roundish impression at middle, the margins of which are obsoletely raised; background of impression with a few very shallow but coarse punctures. Underside rather densely granulate, with the margins of the lateral impressions on upper surface, well-defined also underneath; apophysis bent downwards, minutely pilose. Elytra short and broad, only a little longer than broad, a little broader than pronotum, strongly convex discally, flattened towards sides and with a horizontally depressed submarginal area along lateral edge. Base almost straight, with the middle slightly produced forwards. Humeral angles prominent, nearly rectangular. Sides subparallel anteriorly, broadly rounded and narrowed towards apex. Lateral edge very sharp, strongly complanate, smooth and not denticulate or crenulate. Apical declivity obliquely sloping, with strongly caudate and separated apex. Integument sparsely covered with fine punctures of equal size, and with very fine, scattered and transverse granules in the submarginal depression; pilosity scattered, fine, long and erect, inserted on the submarginal granules, and here and there on those few ones on surface. Suture slightly impressed on apical declivity. Discal convexity strongly sloping towards base; the latter with a fringe of very short yellowish bristles at middle. Reflected portion very broad, sparsely punctured and on intervals between punctures with a few very fine granules; on posterior half with a longitudinal row of some coarser punctures near to epipleural border, and with another one, but much less pronounced, between middle and inner row. Abdomen densely covered with fine and somewhat asperous punctures, shortly pilose. Bristles of tibial edges yellow. Basal joint of posterior tarsi a little longer than ungual joint.

Dimensions: Length  $7 \frac{1}{4}$  to 9 mm., width  $4 \frac{3}{4}$  to  $5 \frac{1}{2}$  mm., height  $2 \frac{1}{4}$  to  $2 \frac{3}{4}$  mm.



**Localities:** Northern Transvaal, Kruger National Park: Groot-draai, Olifants River, October 1927, leg. H. Lang (28 spec., holo- and allotype in T.M., paratypes in T.M. and B.C.M.); Sokolumi, 1932, leg. H. Lang (5 paratypes in T.M.); Klaserie, July 1928, leg. A.G. White (1 paratype, T.M.).

It is a pleasure for me to name this very interesting new species after its discoverer, Dr. H. Lang, Pretoria.

**Systematic position:** This species is easily recognizable by its *Lycanthropa*-like appearance, and the smooth and sharp lateral edge, the foliaceous lateral portions and the well separated caudate apex of elytra.

***Serrichora pogonobasoides* n. sp.**

(Plate V, fig. 132)

Black, dull, pilose. Head above densely covered with irregular, sharply elevate rugosities, and sparse, short, adherent bristles. Epistomal emargination with two strong median teeth. Supra-antennal portions raised, with distinctly sinuate outlines. Supra-orbital crests prolonged and converging towards middle of vertex. Pre-ocular grooves large, separated from one another by a longitudinal, slight median convexity. Apical margin of buccal fissure lobes truncate, with sharply pointed inner angle. Antennae stout; basal joint strongly dilatated towards apex, about as long as apical joint; second joint transverse; third one as long as the two following joints combined, much longer than the basal joint; fourth joint a little longer than broad and longer than second one; the following joints transverse and becoming gradually shorter and broader towards apex; fifth joint one and a third times as broad as long; penultimate joint not quite twice as broad as long; apical joint a little shorter than the two previous joints combined. Pronotum not quite twice as broad as head, about three times as broad as long, sparsely covered with round granules, from which emerge fine and rather long semi-erect hairs. Base of anterior emargination two and a half times as broad as inner lateral margin, furnished with a fringe of dense and short yellowish bristles, becoming longer along lateral margins of emargination. Anterior angles produced up to level with genal angles of head, rounded. Sides irregularly denticulate, rounded and strongly narrowed towards anterior angles, including the widest space of pronotum behind middle, thence rounded and distinctly narrowed towards base; furnished with a few short bristles. Posterior angles rectangular and produced backwards. Base much broader than anterior margin, straight and only close to posterior angles with a distinct sinuosity; covered with a fringe of reddish yellow hairs. Disc across middle with a broad and shallow transverse impression. The folia-

ceous lateral portions slightly excavate at middle. Prosternum rather densely granulate and pilose; the flattened portions of episternum with finer and dense granules; intercoxal apophysis bent downwards. Elytra a little broader than pronotum, about one-fifth longer than broad, strongly convex, covered with rather sparse and very short, erect yellowish bristles. Base obliquely sloping towards humeral angles, arcuate, furnished with a fringe of yellowish bristles. Humeral angles obtusangular and well pronounced. On account of the obliquely sloping lateral portions of base, the open space between the latter and pronotal base appears to be rather wide. Sides slightly rounded and faintly narrowed towards humeral angles, including the widest space on elytra at middle, thence strongly rounded and narrowed towards the caudate apex. Lateral edge fine, but almost complete, ending in front of caudate lobe of apex, irregularly and finely granular anteriorly, becoming more or less denticulate posteriorly. Discal convexity flattened on top, extending to lateral edges, slightly sloping towards base, with strong and rather steep, almost perpendicular apical declivity. Suture slightly raised discally, and flanked by a shallow longitudinal impression on each side. Integument densely covered with fine granules, which become larger and more pronounced on sloping basal, lateral and apical portions; the background between granules appears as if strongly uneven, and is covered with some distinct punctures only on sloping lateral portions. Reflected portion much narrower than abdomen, densely granulate, with the intervals between granules uneven and more or less distinctly foveate. Epipleural carina developed apically, running in a straight line and parallel with the margin of abdomen, prolonged forwards to about level with the middle of third sternite. Underside of afterbody very densely granulate and setulose. Basal, portion of mesosternum with a comparatively strong and complete median carinula. Metasternum short, less than half as long as basal sternite of abdomen. Intercostal process of the latter narrow, only twice as broad as prosternal apophysis. Legs slender, densely covered with yellowish hairs and reddish bristles; basal joint of posterior tarsi a little shorter than ungual joint.

Dimensions: Length  $10 \frac{3}{4}$  to 12 mm., width  $5 \frac{1}{2}$  to 6 mm.

Localities: Southern Angola: Boca da Humpata, Sa'da Bandeira, 21 September 1949, leg. A. de Barros Machado (3 spec., holotype, sex not determined, in M.D., paratypes in M.D. and T.M.); Angola (1 paratype in my collection).

Systematic position: The new species resembles some *Pogonobasis*, and in fact the paratype of my collection originally has been classified by Gebien as *Pogonobasis verrucosa* Erichs. It is, however, decidedly distinguished from all *Pogonobasis* by the straightly truncate apical margin of the buccal fissure lobes, agreeing in this particular with *Eurychora* and

*Serrichora*. As it can not be referred to *Eurychora* on account of the strongly developed apical carina of epipleurae, it has to be placed to *Serrichora*. although it differs much from all the other species of this genus, in the faintly pronounced lateral edge of elytra, the strong convexity of the latter, in the peculiar structure of pronotal and elytral bases, and in the complete median carinula on the basal portion of mesosternum. A further character, which is quite peculiar to the new species, is the straight course of the apical carinula of epipleurae; in all the other *Serrichora* this carinula is distinctly curved. The nearest ally of the new species seems to be *S. punctipennis* (Haag).

***Serrichora punctipennis* Simoesi subsp. n.**

(Plate V, fig. 133)

Differing from the holotype of *S. punctipennis* (Haag) (ex Z.St.S.) as follows :

Elytra longer, with the sides less rounded and the base less arcuate; punctation duplicate, consisting of small primary and minute secondary punctures, with the intervals between punctures distinctly larger than the diameter of primary punctures. In the holotype of *punctipennis* there is only a uniform, dense and coarse, almost foveate primary punctation, with the intervals between punctures partly smaller than the diameter of punctures, partly as large as the latter.

Reflected portion of elytra granulate, with the background between granules uneven and appearing as if shallowly punctured. In the holotype of *punctipennis* with a very dense, deep and foveate punctation, and sparsely granulate on the small intervals between punctures.

Foliaceous portion of episternum of prosternum covered with very fine and scattered granules. In the typical *punctipennis* those granules are much larger and very dense.

Supra-orbital crests confined to inner margin of eyes, and slightly curved inwards; disc of head, between pre-ocular grooves, quite flat. In the holotype of *punctipennis* the supra-orbital ridges are oblique and almost in contact with one another; disc of head between the deep pre-ocular foveae slightly and longitudinally convex, with indication of a fine median carinula.

Locality : Southern Angola : Ruacana, 2 July 1948, leg. University California-Transvaal Museum Expedition (1 spec., holotype, sex not determined, in T.M.).

I name the new form in honour of Mr. José Fernandes Simoes, Chefe de Posto at Naulila.

*Eurychora punctipennis* Haag has turned out to be a *Serrichora*; within this genus, however, it keeps a quite isolate position on account of the widely

open space between pronotum and elytra, the obsolete but smooth and densely ciliate lateral edge of the latter, and the structure of mesosternum. I take it to be allied only to *S. pogonobasoides* n. and *S. murina* (Haag).

**Pogonobasis (Peristepus) gracilicornis n. sp.**

(Plate VI, fig. 140)

Black, a little paler towards sides; moderately shiny; pilose. Head above densely and longitudinally granulate, except for the inter-ocular space, which is impressed at midline, smoothed and covered with only a few fine granules. Lateral contours of supra-antennal portions slightly sinuate in front of genal angles. Supra-orbital edges convergent. Antennae thin, hardly accrescent towards apex; third joint longer than basal one, about as long as the two following joints taken together; fourth and fifth joints distinctly longer than broad; the following joints very slightly transverse; penultimate joint only one-third broader than long; apical joint almost twice as broad as penultimate one, a little shorter than the two previous joints taken together, and a little longer than basal joint. Pronotum three times as broad as long, very sparsely granulate on lateral portions, and sparsely covered with some erect and fine, rather short hairs. Middle of disc with a deep and sharp, linearly sulcate, transverse impression. Base of anterior emargination a little more than twice as long as inner lateral border, furnished with a fringe of dense yellowish bristles. Sides strongly rounded and narrowed towards anterior margin, as well as base. Posterior angles broadly rounded. Base straight, with two reflected teeth, which are concealed by a fringe of yellowish bristles. Lateral edge sharply and sparsely denticulate, with some very long cilia. Prosternum with a few granules; episternum covered with some very scattered, coarse but shallow punctures, intermixed with sparse granules; apophysis with perpendicular declivity. Elytra broadly oval; a little broader than pronotum, slightly convex, sloping towards base, faintly caudate. Base very slightly arcuate, ciliate at middle. Lateral edge reflected and sharply denticulate, longly ciliate. Sides rounded, gradually narrowed towards humeral angles; the latter obtuse and slightly raised. Integument covered with sparse and coarse punctures, with the intervals between punctures uneven and bearing some scattered and fine setiferous granules. Reflected portion densely and coarsely punctured, with sparse granules on intervals between punctures.

Dimensions: Length 10 mm., width  $4\frac{3}{4}$  mm., height  $2\frac{1}{2}$  mm.

Locality: Tanganyika Territory: Olduway, August 1941 (1 single holotype, sex not determined, ex Coryndon Museum, in B.M.).

Systematic position: Closely related to *P. conformis* Lesne, but the elytra broader and more rounded; the pronotum with broadly rounded



posterior angles and with concealed basal teeth; the latter bent downwards, not porrect and not exposed as in *conformis*; only the two penultimate joints of antennae are slightly transverse and the apical joint is two thirds broader than the slender previous joint, or a little broader (in *conformis* all the intermediate joints five to nine are strongly transverse and very stout, whilst the apical joint is about as broad as the penultimate joint).

**Pogonobasis (Peristeptus) Pinheyi n. sp.**

(Plate V, fig. 137)

Black, extremities and underside reddish brown; head dull, pronotum and elytra shiny; pilose. Head above very densely covered with longitudinal rugosities and short, adherent yellowish bristles. Contours of supra-antennal portions slightly sinuate. Supra-orbital edges obliquely prolonged towards middle of vertex. Underside densely rugose. Apical margin of the large buccal fissure lobes slightly triangular. Third joint of antennae longer than basal joint, one and a half times as long as fourth joint and only a little shorter than the two following joints combined; fourth joint distinctly longer than broad; fifth joint approximately square; the following joints slightly transverse, with the penultimate joint one and a half times as broad as long; apical joint shorter than the two previous joints combined, and distinctly shorter than basal joint. Pronotum two and a half times as broad as long, shortly pilose. Base of anterior emargination almost two and a half times as long as inner lateral margin. Sides irregularly denticulate, strongly rounded and less narrowed towards base than to anterior angles. Base almost straight, with obtuse posterior angles. Disc slightly convex, strongly shiny, without median impression, covered with a few fine punctures. Lateral portions faintly raised, sparsely granulate. Prosternum with a few granules, transversely sulcate across middle; apophysis bent downwards, with the apical declivity densely pilose; episternum rather densely covered with granules. Elytra oblong, not broader than pronotum, convex, not caudate. Base with the lateral parts obliquely sloping towards the obtuse humeral angles; the latter slightly raised. Sides subparallel, behind middle slightly rounded and narrowed towards apex. Lateral edge reflected, shortly and finely denticulate, furnished with long cilia. Integument covered with a very coarse almost foveate punctation, arranged in slightly indicated longitudinal rows along suture, with the intervals between punctures partly smaller than the diameter of punctures, and covered with a few fine granules, becoming more concentrated towards sides. Apical declivity moderate, with the sculpture becoming evanescent towards apex. Reflected portions very densely and coarsely punctured, and sparsely granulate on intervals between punctures. Abdomen with rather

dense and somewhat asperous punctation, partly intermixed with granules. Basal joint of posterior tarsi as long as the two following joints taken together, and much longer than ungual joint.

Dimensions: Length 11  $\frac{3}{4}$  mm., width 4  $\frac{3}{4}$  mm., height 3 mm.

Locality: British East Africa: Elgon, March 1938, leg. T.H.E. Jackson (1 single holotype, sex not determined, ex Coryndon Museum, in B.M.).

Named in honour of Mr. E.C.G. Pinhey, Entomologist to the Coryndon Museum, Nairobi.

Systematic position: Owing to the general shape and sculpture of body, the dense sculpture of inter-ocular space on head, and the formation of antennae, *P. Pinheyi* could only be confused with *P. marginalis* Geb.; it is, however, easily distinguished from this species in the broadly and evenly convex, shiny disc of pronotum, the elongate and apically flattened elytra, and the sinuate lateral contours of the supra-antennal portions. From the species, lacking likewise a discal impression on pronotum, viz., *P. cribratus* Gerst. and *P. ovatus* Fahr., the new species differs in the slender and elongate body, the not caudate elytra, the densely sculptured inter-ocular space, and in the formation of extremities.

Gebien, 1937, considered his *marginalis* to be synonymous with *cribratus*, after having found the type of *cribratus* identical with *marginalis*. I can not agree with this opinion, for *marginalis* shows constantly a complete transverse median sulcus across disc of pronotum, while in the three species *cribratus*, *ovatus* and *laevigatus* this sulcus is absent, as the disc is longitudinally convex at midline (cf. also Gerstaecker, 1862, and Gebien, 1937, sub *laevigatus*). Apart from this particular, however, there are many other differences between *marginalis* and *cribratus*. In *marginalis* the body is much slenderer, the sharply denticulate edge of elytra is reflected and separated from the discal convexity of elytra by a narrow and channelled submarginal area (cf. also Lesne, 1922), the inter-ocular space on vertex is densely sculptured, and the elytra are flat; in *cribratus* the body is much broader, the lateral edge of elytra is only sometimes reflected at its anterior half and never sharply denticulate, but only crenulate or granulate, the inter-ocular depression on vertex is smoothed, and the elytra are rather strongly convex, without showing a distinct submarginal depression.

**Pogonobasis (Peristeptus) Gestroi somalica subsp. n.**

Constantly differing from typical *Gestroi* (Haag) and its holotype (ex Z.St.S.) by the shorter, smooth and almost impunctate elytra and the obtusely rounded shoulders of the latter.

Localities : British Somaliland : Burao, August 1941, leg. Capt. J.R. Audy (1 spec., holotype, sex not determined, ex Coryndon Museum, in B.M.); same locality, July 1942, leg. Capt. J.R. Audy (1 paratype in C.M.); Gal Mudugh Province, 700 feet, May 1945, leg. T.H.E. Jackson (1 paratype in T.M.). — Abyssinia : Dire Dawa, 20 July 1942, leg. Meneghetti (1 paratype in B.C.M.).

**Pogonobasis (Peristeptus) tangana n. sp.**

(Plate VI, fig. 148)

The new species is closely related to *P. Gridellii* Geb., 1937, differing from it as follows :

Size smaller : 7 1/2 to 9 1/2 mm. long (in *Gridellii* 10 to 12 1/2 mm. long).

Elytra more elongate, with much deeper, almost excavate basal impressions, and with the integument, that of reflected portions included, very densely covered with a coarse and foveate punctation, with the intervals between punctures much smaller than the diameter of punctures and very finely punctured; the space between the deep scutellar and median impressions of base strongly raised, with the base of each elytron thereby appearing as if provided with a short, slightly prominent, longitudinal callus along scutellar impression. Moreover the elytra are more elongate and strongly convex, with the lateral edge less sharply developed and slightly crenulate apically. In *Gridellii* the punctures on elytra are very fine, with the intervals between punctures much larger than the diameter of punctures; the median impressions of base are less deep, with the space between the latter and the scutellar impression moderately convex and not forming a callus.

The pronotum is a little narrower and shows on middle of disc two rounded impressions, which are sharply separated from one another by a rather broad convexity along midline. Episternum of prosternum densely covered with elevate and sharp granules, with the background of cuticula densely with elevate and sharp granules, with the background on episternum of prosternum is less dense and finer, somewhat abraded, with only a few foveate punctures along midline.

The head is much narrower, with the genal outlines less projecting outwards; inter-ocular space broader and not impressed; supra-orbital crests less converging forwards.

The antennae are less incrassate; third joint only as long as the basal one, and hardly as long as the two following joints taken together; fourth joint as long as the second one; the pre-apical joints are less transverse. In *Gridellii* the third joint is considerably longer than the basal one, and as long as the two following joints combined; the fourth joint is distinctly longer than the second one.

The granulation on underside of body is stronger and more elevate; the mesosternal apophysis is as broad as the prosternal one (in *Gridellii* a little narrower than the latter), and the lateral impressions on metasternum and basal sternite, well pronounced in *Gridellii*, are hardly indicated.

Locality: Tanganyika Territory: Kilossa, 15 April 1921, leg. Loveridge (5 spec., holotype, sex not determined, in T.M., paratypes in T.M., Agricultural Department, Salisbury, and B.C.M.).

I do not know the subspecies *aterrima* Geb., 1937, of *Gridellii*, but, according to the description, it may be found to be different in the shiny integument and the very sharp lateral edge of elytra.

*P. scutellaris* Haag, 1878, which I do not know, seems to be allied to the new species. According to the description, it is also a small species, very well agreeing with *P. tangana* in the raised convexities along the scutellar impression of elytral base, and in the length of the third antennal joint; but as the lateral edge of elytra is indicated to be very sharp, bent upwards and smooth, it can not be referred to *tangana*, for in this species the lateral edge is obtuse, not at all reflected and subcrenulate.

***Pogonobasis (Peristeptus) bisulcata* n. sp.**

(Plate VI, fig. 144)

Blackish brown, with the lateral portions of pronotum and extremities reddish brown; elytra and disc of pronotum very shiny; pilose. Head above densely covered with rugose and confluent granules, becoming evanescent at midline; pilosity short, adherent and yellowish. Inter-ocular space about twice as broad as the longitudinal diameter of eyes, smoothed, and with a few scattered rugosities. Median teeth of epistomal emargination minute and obsolete. Supra-antennal portions strongly raised, with distinctly sinuate outlines. Supra-orbital crests curved, strongly convergent anteriorly, slightly produced backwards. Submentum about twice as broad as long, anteriorly with dense and rugose reticulation, but without distinct transverse carina. Apical margin of buccal fissure lobes slightly triangular. Antennae short and strongly incrassate; third joint only one and a half times as long as broad, a little longer than basal joint, and distinctly shorter than the two following joints combined; all the following joints transverse, becoming gradually broader towards apex; the two penultimate joints about twice as broad as long; apical joint a little narrower than penultimate joint, but only a little shorter than the two previous joints taken together. Pronotum broadest at middle, there about three times as broad as long, covered with sparse and very short, erect yellowish bristles. Base of anterior emargination two and a half times as long as inner lateral margin, furnished with a fringe of



short yellowish bristles. Sides strongly rounded and narrowed from middle to anterior angles, straight and almost subparallel from middle to base. Lateral edge with fine and sparse denticulation and very short yellowish bristles. Posterior angles obtusely rectangular. Base at each side with a strong and porrect tooth midway between posterior angles, with the portion between those teeth deeply bisinuate and densely covered with a brush of yellowish golden bristles at each side of the produced middle; lateral portions of base, between teeth and posterior angles almost straight and furnished with a fringe of short yellowish hairs. Disc shiny, uniformly convex, here and there covered with some fine setiferous granules, with a very shallow roundish impression on each side of middle. Lateral portions slightly excavate, hardly raised above level of discal convexity, and covered with sharp and scattered setiferous granules; there is a slightly oblique longitudinal row of six to seven deeply impressed punctures on middle of lateral portions. Underside sparsely granulate; outer margin of the slightly indicated antennal sulcus on episternum of prosternum with an oblique longitudinal row of foveate and coarse punctures; apical declivity of intercoxal apophysis densely pilose. Elytra oval, about one-quarter longer than broad, broadest at middle, a little broader than pronotum, with sharp, complete and smooth lateral edge, and with a very characteristic deep longitudinal sulcus at about middle of the basal half of each elytron, sharply delimiting the discal convexity, and with a deep triangular impression on scutellar portion. Base with produced median lobe; lateral portions slightly sloping towards humeral angles; furnished with a dense and brush-like fringe of yellowish golden bristles, interrupted in front of scutellum; the median lobe as broad as pronotal base between the two porrect teeth. Humeral angles sharp, almost rectangular and strongly bent upwards. Sides slightly rounded and narrowed towards humeral angles, strongly narrowed to apex. The sharp lateral edge bears a few fine and moderately long yellowish cilia. Apical declivity rather steep; apex with slightly indicated caudate lobe, the sides of which are obsoletely crenulate and rounded apically. Discal convexity rather strong and, in caudal view, separated from the reflected lateral edge by a narrow submarginal area; on anterior half it is sharply separated from the lateral surface by the characteristic longitudinal sulcus, which is situated much nearer to the lateral edge than to suture. Integument very densely covered with a foveate and irregular punctation on disc, becoming evanescent towards sides and on apical declivity; intervals between punctures a little smaller than diameter of punctures, and covered with some scattered and extremely fine granules, from which originate scattered and very short erect bristles, intermixed with a few longer hairs. Reflected portions coarsely punctured, with the punctures obsoletely arranged in longitudinal rows, and with the intervals

between punctures bearing a few almost microscopic granules. Underside of afterbody with very scattered granules, smooth at sides. Legs densely covered with yellowish bristles; basal joint of posterior tarsi distinctly shorter than ungual joint.

Dimensions: Length 5 1/2 to 7 mm., width 3 to 3 3/4 mm., height 1 3/4 to 2 mm.

Localities: Tanganyika Territory: Lukuledi, 1905, ex coll. J. N. Ertl (3 spec., holotype, sex not determined, in Z.St.S., paratypes in Z.St.S. and T.M.). — Madagascar: Ananalava (1 paratype in Institut Royal Sciences Naturelles, Bruxelles).

Systematic position: This species can be scarcely confused with any of the other *Pogonobasis*, from which it is strikingly distinguished by the strongly raised median portion of the anterior half of elytra, which at each side is bordered by a longitudinal sulcus, and the peculiar formation of the base of pronotum.

The three typical specimens from Lukuledi have been classified originally as *scutellaris*, but it seems to me quite impossible to refer them to the latter, as Haag mentions neither the peculiarity of the bisulcate elytra, nor the characteristic formation of the bidentate pronotal base (Haag, 1875, loc. cit.: "Hinterrand des Halsschildes fast gerade.."); also the proportions of antennal joints seem to be different, as the third joint is indicated to be as long as the two following joints taken together, while it is much shorter than the two following joints combined in the new *bisulcata*.

***Pogonobasis* (s. str.) *submarginata* n. sp.**

(Plate VI, fig. 142)

Black, palpi piceous; shiny; pilose. Head above covered with dense and confluent rugosities, except for the pre-ocular grooves and inter-ocular space, where the sculpture is very scattered. Median teeth of epistomal emargination obsolete. Supra-antennal portions strongly raised, with sinuate lateral contours. Pre-ocular grooves small, roundish and deep. Supra-orbital ridges obliquely produced towards middle of vertex, converging. Pilosity sparse and composed of short and adherent yellowish bristles. Apical margin of submentum subcarinate. Apical margin of buccal fissure lobes triangular. Antennae rugosely punctured, with a few minute yellowish bristles, moderately accrescent towards apex; basal joint a little longer than the third one, practically of equal length; third joint one and a third times as long as broad, about one and a half times as long as the fourth joint, and distinctly shorter than the two following joints combined; fourth joint a little longer than broad; fifth joint as long as broad; the following joints transverse, becoming gradually shorter and more transverse towards apex; the two pre-

apical joints not quite twice as broad as long; apical joint large, distinctly shorter than the two pre-apical joints combined. Pronotum broadest a little before middle, not quite twice as broad as head, two-thirds broader than long. Base of anterior emargination two and a half times as long as inner lateral margin; the latter separated from the base of emargination by a deep and small, semi-circular incision, with dentiform inner angles and distinctly projecting inwards beyond basal incision. Sides irregularly denticulate, rounded and dilated from anterior angles towards middle, thence rounded, but less narrowed towards posterior angles; the latter slightly obtusangular. Base straight, with an obsolete and shallow emargination at middle. Lateral portions faintly concave, with moderately raised lateral edges. Disc with a rather deep and transverse impression, separating the anterior convexity from the basal one; the latter impressed at middle. Integument covered with a few primary granules, a little more concentrated along anterior margin and on sides; the secondary granulation is very obsolete, practically absent. Pilosity on anterior margin long and brush-like, of a pale reddish yellow tint, that on base shorter, but dense and of a more brownish red colour; the hairs on surface are long and yellow, very scattered, adherent discally, erect on lateral portions. Granulation on prosternum very sparse, that on episternum much denser and rougher; apophysis with brush-like yellow pilosity on apical declivity. Basal surface of prothorax, examined in sectional view, inermous. Elytra broadest behind middle, a little broader than pronotum, with distinct obtusangular shoulders, and slightly rounded, almost subparallel sides. Basal surface impressed at suture, and between discal convexity and humeral margin. Lateral edge well pronounced, subcarinate basally, becoming gradually evanescent towards apex. Apical declivity rather steep, obliquely sloping downwards. Punctuation very variable, more or less foveate and more or less dense, with the intervals between punctures sometimes larger than the diameter of punctures, often much smaller than those, and in the latter case forming some kind of an irregular reticulation; but constantly this punctation becomes fine, sparse and evanescent on sloping basal and apical portions; intervals between punctures covered with fine granules. Pilosity sparse, erect and of a yellowish colour, composed of short secondary hairs and longer primary ones along suture, the two hardly indicated dorsal ridges and on lateral margin; the brush-like pilosity of base of an intensely reddish yellow tint. Lateral contours of elytra, viewed from above, appearing as if smooth, except for the slightly caudate apex, where some obsolete dentiform granules project beyond those outlines. Reflected portion densely and coarsely punctured, with granulate intervals between punctures. Underside of afterbody sparsely punctured and granulate, with adherent short yellowish hairs discally; intercoxal

process of basal sternite of abdomen a little more than twice as broad as prosternal apophysis. Legs simple, the tibiae with red bristles along lateral edges; basal joint of posterior tarsi shorter than ungual joint.

Dimensions: Length  $9 \frac{3}{4}$  to  $11 \frac{1}{2}$  mm., width  $4 \frac{3}{4}$  to  $5 \frac{1}{2}$  mm., height  $3 \frac{1}{2}$  to 4 mm.

Localities: Belgian Congo: Albertville, December 1918, leg. R. Mayné (56 spec., holo- and allotype in B.C.M., paratypes in B.C.M. and T.M.); Albertville, 1936, leg. Häslı (1 paratype in B.C.M.); same locality, 15 November 1946, Miss. Tanganyika (2 paratypes in I.R.); Tanganyika-Moero: Nyunzu, January-February 1934, leg. De Saeger (3 paratypes in B.C.M.).

Systematic position: The new species is related to *P. cognata* Lesne; it differs from this species as follows:

Body slenderer and of larger size. The lateral edge of elytra is more developed, smooth and not appearing as if denticulate (in *cognata* the lateral edge, viewed from above, is smooth only along the humeral portion, whereas it becomes resolved into separated dentiform granules on apical half). The elytra are more elongate, less convex and distinctly flattened discally; their sides are less rounded, only slightly narrowed in front of base, with the shoulders more pronounced (strongly obtusangular in *cognata*); the pilosity is shorter. The pronotum is a little longer, with the lateral portions, viewed from behind, distinctly projecting above level of disc (in *cognata* not projecting above level of disc). The intercoxal process of basal sternite of abdomen is as broad as the submentum, or broader, in *cognata* narrower than the latter. The antennae are more incrassate, with the basal joint a little longer than the third joint (as long as that in *cognata*).

Another closely allied species is *P. magna* Geb.; it agrees with *submarginata* n. in the smooth outer contours of elytra, but is easily distinguished by the large size (11 to 14 mm. long), the complete transverse sulcus across middle of pronotum, the almost rectangular shoulders, the fine and scattered punctation on elytra, and the elongate third joint of antennae, which is about as long as the two following joints combined, and distinctly longer than the basal joint.

On account of the indicated or even distinct marginal edge of elytra, the new species together with the old *cognata* and *magna*, as well as several other new forms, are intermediate between the *Pogonobasis* s.str. and *Peristepus*.

***Pogonobasis* (s. str.) *denticollis* n. sp.**

(Plate VI, fig. 143)

The new species is easily distinguished from all the other *Pogonobasis* s. str. by the strongly dentate base of pronotum. It is closely related to the



previous species, viz., *P. submarginata*, from which it differs as follows :

Base of pronotum straight and at each side, between middle and posterior angles with a strong and porrect tooth, which is slightly curved inwards apically, separating the brush-like pilosity of the median portion of base from the lateral one. Head smaller, above covered with a very dense and rugose sculpture throughout, also on inter-ocular space, where the sculpture is very sparse in *submarginata*. Lateral margin of pronotum with stronger denticulation; the posterior angles more restricted and therefore more strongly obtusangular. Shoulders more developed, almost rectangular, with the humeral margin strongly bent upwards. Secondary bristles between the longer hairs of the primary intervals on elytra shorter, but much denser than in *submarginata*. Intercoxal process of basal sternite of abdomen much narrower than submentum. Antennae slenderer, with the pre-apical joints less transverse; third joint distinctly longer, one and a half times as long as broad. Basal joint of posterior tarsi about as long as ungual joint.

Dimensions : Length 9 to 10 mm., width  $4 \frac{3}{4}$  to 5 mm., height  $3 \frac{1}{4}$  mm.

Locality : Belgian Congo : Albertville, 4 December 1918, leg. R. Mayné (12 pec., holo- and allotype in B.C.M., paratypes in B.C.M., and T.M.).

The typical series was collected together with that of *submarginata*.

A series from the Tanganyika Territory (Tosa, Uhuru, 5 spec. in Z.St.S.) differs from the types in the larger size ( $10 \frac{1}{2}$  to  $11 \frac{1}{2}$  mm.).

#### **Pogonobasis (s. str.) denticollis ovipennis subsp. n.**

Constantly differing from the typical *denticollis* by the rounded shoulders, the absence of the basal impressions on elytra, the less dense and less coarse punctation of the latter and the longer, less incrassate antennae.

In the typical *denticollis* the shoulders are well developed, slightly oblique, with the lateral margin bent upwards; the sides of elytra are parallel in front of shoulders. In the new subspecies the shoulders are completely rounded, flat, without reflected margins, and continuous with the sides of elytra, which are gradually narrowed towards base.

There are distinct basal impressions on elytra in the typical *denticollis* : a scutellar impression and a shallow but distinct one near to humeral portions.

The third antennal joint is shorter in the typical *denticollis*; it is hardly longer than the basal joint, and distinctly shorter than the two following joints combined. In the new subspecies it is much longer than the basal joint, and exactly as long as the fourth and fifth joints taken together.

Locality : Tanganyika Territory : Madibira (3 spec., holotype, sex not determined in Z.St.S., paratypes in Z.St.S. and T.M.).

**Pogonobasis (s. str.) denticollis rukwana subsp. n.**

(Plate VI, fig. 145)

Agreeing with the typical *denticollis* in the formation of shoulders, but differing from it by the broader elytra, which show a finer punctation and larger intervals between punctures, and by the antennal proportions, which are similar to those in *denticollis* subsp. *ovipennis*.

Localities : Tanganyika Territory : E. Rukwa, 3500 feet, April 1938, leg. D.G. MacInnes (2 spec., holotype, sex not determined, ex Coryndon Museum, in B.M., paratype in C.M.); L. Rukwa area, 3700 feet, April 1938, leg. D.G. MacInnes (2 paratypes in T.M.).

**Pogonobasis (s. str.) armata n. sp.**

(Plate VI, fig. 141)

Owing to the two strong and porrect basal teeth of pronotum this species comes near to *denticollis*, from which it is distinguished as follows :

Inter-ocular space smoothed, with only a few fine granules (densely sculptured in *denticollis* and subspecies). Elytra much broader and resembling the species of the *Gestroi-Gridellii*-group; they are much less convex and almost subtruncate basally, with nearly rectangular shoulders and rather deep basal impressions at scutellar portion and near to humeral portions. The lateral edge is obtuse, but rather well pronounced basally and apically. The integument is covered with a rather scattered and moderately coarse punctation, with the intervals between punctures a little larger than diameter of punctures. The sides are slightly rounded, but abruptly narrowed in front of the caudate apex, which, in dorsal view, is strongly demarcated from the lateral contours of apical declivity (in *denticollis* and subspecies the caudate apex, viewed from above, is hardly demarcated from the contours of the sides; the latter are gradually narrowed towards apex). In the proportions of antennae the new species agrees well with *P. denticollis* ssp. *rukwana*.

Owing to the nearly entire lateral edge of elytra and subquadrangular shape of the latter, *P. armata* resembles some typical *Peristepus*; but from all those *Peristepus*, having a smooth and not denticulate lateral edge of elytra, the new species is immediately distinguishable by the porrect teeth of pronotal base.

Dimensions : Length  $9 \frac{1}{4}$  to 12 mm., width  $5 \frac{1}{2}$  to  $6 \frac{3}{4}$  mm., height  $2 \frac{3}{4}$  to  $3 \frac{1}{4}$  mm.

Localities: Tanganyika Territory: Bihawana (2 spec., holotype, sex not determined, in Z.St.S., paratype in T.M.); Kongwa, March 1949, leg. W.A. Young (1 paratype, ex Coryndon Museum, in B.M.).

***Pogonobasis* (s. str.) *bisinuata* n. sp.**

(Plate VI, fig. 146)

Black, palpi reddish brown; shiny; pilose. Head above very densely covered with granular rugosities all over the surface, the inter-ocular space included; pilosity sparse, consisting of short, semi-erect bristles of a pale yellowish tint. Median teeth of epistomal emargination short. Supra-antennal portions slightly raised, with practically straight lateral outlines. Pre-ocular grooves large and roundish. Supra-orbital ridges oblique, well separated from one another. Submentum not carinate apically. Apical margin of buccal fissure lobes triangular. Antennae covered with short hairs of a pale reddish yellow tint, strongly accrescent towards apex; basal joint distinctly shorter than third joint; the latter slender not quite twice as long as broad, almost as long as the two following joints taken together, and one and a half times as long as fourth joint, distinctly longer than apical joint; fourth joint hardly longer than broad; the following joints transverse, becoming gradually shorter and more transverse towards apex, with the pre-apical joints about twice as broad as long; apical joint distinctly shorter than the two previous joints taken together. Pronotum broadest a little behind middle, there twice as broad as head, and about three times as broad as long. Base of anterior emargination about three times as broad as inner lateral margin, and separated from the latter by a small semi-circular incision. Anterior angles obtusely rectangular. Sides rather regularly denticulate, rounded and gradually dilated from anterior angles towards the broadest point of pronotum, thence rounded and slightly narrowed towards base. Posterior angles slightly obtusangular. Base much broader than anterior margin, almost straight, with a small emargination at each side from median portion. Lateral surfaces slightly excavate, with faintly raised lateral edges. Disc with transverse impression across middle, interrupted at midline by a slight longitudinal convexity. Integument with sparse sculpture; there are larger primary granules on lateral surfaces and on the shiny median convexity, whereas some finer secondary granules are sparsely spread all over the surface. The pilosity is of a reddish yellow tint, very short and bristle-like along the lateral margin, longer and brush-like and easily to be rubbed off on surface. Underside rather densely covered with fine setiferous granules, those on episternum of prosternum larger but hardly denser; pilosity more concentrated on intercoxal apophysis. Basal surface of prothorax, examined

in sectional view, inermous. Elytra moderately convex, flattened discally, shoulderless, broadest at about middle, there a little broader than pronotum. Sides strongly and broadly rounded and narrowed towards base, almost subparallel along middle, rounded and narrowed towards apex. Basal surface evenly convex, sloping towards scutellar portion; the latter furnished with a brush of dense hairs of a reddish yellow tint. Apical declivity rather steep, obliquely sloping. Integument very densely covered with a coarse, almost foveate and deep punctation, more or less arranged in longitudinal rows; the intervals between punctures much smaller than diameter of punctures, forming a kind of reticulation, and covered with primary and secondary granules. Suture broadly smoothed; two dorsal ridges and a lateral one very slightly indicated on each elytron. Lateral edge very fine, but pronounced; the outlines of elytra, viewed from above, appear as if sparsely denticulate along the apical third. The yellowish pilosity consists of very short, dense erect bristles, intermixed with very fine and long erect hairs along suture, the two primary dorsal intervals and lateral margin. Reflected portions sculptured as on upper surface; epipleural carinula almost straight and hardly bent upwards. Underside of afterbody with comparatively dense and fine, slightly transverse punctation, intermixed with a few granules; the latter better pronounced along apical margin of abdominal sternites. Intercoxal process of basal sternite of abdomen truncate, about twice as broad as prosternal apophysis. Legs slender; bristles of tibial edges of a reddish orange tint; basal joint of posterior tarsi a little longer than ungual joint.

Dimensions: Length 8 to 9 1/2 mm., width 4 to 5 mm., height 2 1/2 to 3 mm.

Localities: Belgian Congo: Albertville, 4 December 1918, leg. R. Mayné (20 spec., holo- and allotype in B.C.M., paratypes in B.C.M. and T.M.); Lomami: Kamina, 1930, leg. R. Massart (1 paratype in B.C.M.); Bokote (Equateur), 30 Dec. 1917, leg. R. Mayné (1 paratype, B.C.M.); Tanganyika-Moero: Nyunzu, January to February 1934, leg. De Saeger (5 spec., B.C.M.); Nyunzu: Mulongo, 20 to 30 May 1930, leg. P. Gérard (1 paratype, B.C.M.).

Systematic position: *P. bisinuata* is a quite isolated species, well characterized in the shoulderless, shiny and discally flattened elytra, showing a very concentrated, foveate and longitudinally arranged punctation, fine lateral edges and a contrasting duplicate pilosity; the densely sculptured head, peculiar by its semi-erect pilosity and the nearly straight lateral outlines of supra-antennal portions.

From the difficult group of the shoulderless and dull *Pogonobasis* s. str., the new species is distinguished, apart from the above mentioned peculiarities, by the shape of elytra, which are broadest and subparallel at middle,



having the sides broadly rounded and abruptly narrowed towards the base in front of the latter; by the very narrow intercoxal process of the basal sternite of abdomen, which is much narrower than the submentum; and finally by the strongly accrescent antennae, the third joint of which is elongate and practically as long as the two following joints taken together. Very characteristic for the new species is also the distinctly bisinuate middle of pronotal base.

I do not know of any species of *Pogonobasis*, into whose relationship the new species could be placed, although it was collected together with the two previously described species, viz., *submarginata* and *denticollis*, at Albertville.

***Pogonobasis* (s. str.) *nigrosetosa* n. sp.**

(Plate VII, fig. 149)

Black to brownish black, palpi reddish. Head above densely covered with granular and confluent rugosities, which become very scattered only on inter-ocular space and in the pre-ocular grooves. Median teeth of epistomal emargination sharp and shiny, but minute. Supra-antennal portions slightly raised, with sinuate lateral outlines. Pre-ocular grooves round and large. Supra-orbital ridges oblique and widely separated on middle of vertex. Submentum subcarinate apically. Apical margin of buccal fissure lobes distinctly triangular. Antennae covered with sparse setae of a dark reddish tint, strongly accrescent towards apex; basal joint about as long as third joint; the latter shorter than the two following joints combined; fourth joint distinctly longer than broad; fifth joint square; the following joints moderately transverse and becoming gradually broader towards apex; apical joint almost as long as the two previous joints combined, nearly twice as broad as the third joint. Pilosity of the upper surface of head, especially on epistomal portion, semi-erect and of a reddish tint. Pronotum broadest behind middle, twice as broad as head, about three times as broad as long. Base of anterior emargination about three times as broad as inner lateral margins. Sides irregularly denticulate, rounded and strongly dilated from anterior angles towards base, and strongly narrowed in front of posterior angles. The latter obtusely rounded, the anterior angles obtusely acutangular. Base broadly and shallowly emarginate at middle. Lateral portions slightly concave, with raised margins. Disc across middle with a transverse impression, which is distinctly interrupted at midline. Integument with very sparse sculpture: a few widely spaced larger primary granules are situated along the lateral margins, and arranged in a transverse row along anterior margin, in front of the median transverse impression, and along base; the much finer secondary granules are sparsely spread all over the surface; an extremely fine and con-

glomerated tertiary micro-granulation is perceptible on the slightly convex middle of pronotum. The pilosity consists of short setae of a dark brown colour on lateral edges, long and brush-like hairs of an intense reddish brown on base of anterior emargination and base, and of short and erect bristles of a blackish brown tint on surface. Underside with scattered and setiferous granules; apophysis densely covered with adherent yellow bristles, becoming denser and somewhat brush-like on apical declivity. Basal surface of prothorax, examined in sectional view, inermous. Elytra shoulderless, broadest at about middle, there broader than pronotum in the ♀, slightly rounded and strongly narrowed towards base, without lateral edge. Base distinctly narrower than pronotal base. Apical declivity rather steep, almost perpendicular in front of apex. Integument densely covered with foveate punctures; suture smooth and slightly raised; often with indication of one or two dorsal ridges on each elytron; intervals between punctures anastomosing and forming a kind of reticulation, densely covered with very fine secondary granules, intermixed with a few slightly dentiform primary granules towards sides. Base furnished with a brush-like fringe of hairs of a pale reddish brown colour; surface densely covered with erect and short secondary bristles of a dark brown or reddish brown, and hardly longer primary bristles of the same tint along suture, lateral margin and arranged in two longitudinal rows on dorsum of each elytron. In dorsal aspect, the contours of the sides appear as if sparsely denticulate, owing to the prominent outlines of some of the dentiform primary granules on sides. Reflected portions with dense and foveate punctures, between the latter with fine granules. Underside of after-body sparsely granulate and setiferous discally. Intercoxal process of basal sternite of abdomen twice as broad as prosternal apophysis. Bristles of tibial edges of a dark red or reddish brown. Basal joint of posterior tarsi about the length of ungual joint.

Dimensions: Length 9 to 11 mm., width 5 to 6 mm., height 3 1/2 to 4 mm.

Localities: Belgian Congo: Kapanga (Lulua), September to March 1932-1933, leg. G.F. Overlaet (29 spec., holo- and allotype in B.C.M., paratypes in B.C.M. and T.M.); S. Kapelekese (Lulua), 17 September 1933, leg. G.F. Overlaet (8 paratypes, B.C.M.); River Kalani, Lulua, 14 October 1933, leg. G.F. Overlaet (15 paratypes, B.C.M.); River Luisa (Lulua), 11 October 1933, leg. G.F. Overlaet (3 paratypes, B.C.M.); Kafakumba (Lulua), October 1932, leg. G.F. Overlaet (1 paratype, B.C.M.); River Lunkinda (Lulua), September 1933, leg. G.F. Overlaet (4 paratypes, B.C.M.); River Kaongwesi (Lulua), September 1933, leg. G.F. Overlaet (1 paratype, B.C.M.); Kabinda, 1935, leg. P. Henrard (14 paratypes, B.C.M.); Katoka (Luluabourg), 1939, leg. R.P.N. Vankerckhoven (3

paratypes, B.C.M.); Kamina (Lomami), 1930, leg. R. Massart (7 paratypes, B.C.M.); Kaniama (Lomami), 1931, leg. R. Massart; Yangambi, June 1937, leg. J. Henry (1 paratype, B.C.M.); Elisabethville, September 1930, leg. R. Massart (1 paratype, B.C.M.); Katanga: Kongolo, December 1920, leg. Mme. Passan (6 paratypes, I.R.); Kinda, December 1926 (1 paratype, I.R.). — Tanganyika Territory: Kate, 31 July 1943, leg. H.J. Brédo (1 paratype, I.R.); Ufipa Plateau (3 paratypes, Z.St.S.).

**Systematic position:** The new species belongs to the group of shoulderless *Pogonobasis*: it is closely related to *P. bechuana* Hesse, from which it is readily distinguished by the dark pilosity on upper surface of body and tibiae (which is of a pale yellowish colour in *bechuana*).

***Pogonobasis* (s. str.) *nigrosetosa sandoana* subsp. n.**

(Plate VII, fig. 151)

Constantly differing from the typical form of *nigrosetosa* in the more strongly developed costal sculpture on elytra. The inner dorsal ridge is well pronounced, the outer one often indicated, and the dorsal surface is well separated from the reflected portion by a distinctly edged lateral margin. In caudal view, the erect pilosity on elytra is distinctly longer on costal intervals than on the remaining background. The antennae are a little stouter.

**Localities:** Belgian Congo: Sandoa, November 1931, leg. G.F. Overlaet (8 spec., holo- and allotype in B.C.M., paratypes in B.C.M. and T.M.); Muteba (Lulua), May and November 1931, leg. G.F. Overlaet (4 paratypes, B.C.M.).

***Pogonobasis* (s. str.) *brevicornis* n. sp.**

(Plate VII, fig. 152)

Owing to the shoulderless elytra and the general appearance, the new species resembles to a high extent *P. nigrosetosa*, from which it is distinguished as follows:

Antennae stouter; basal joint small, but distinctly longer than the abbreviate third joint; the latter only a little longer than broad and only a little longer than fourth joint, thereby much shorter than the two following joints taken together; fourth joint as long as broad; the following joints transverse, becoming gradually broader towards apex, with the preapical joints strongly transverse, about twice as broad as long. Pilosity on upper surface of head yellow, short and adherent. The brush-like pilosity on apical declivity of prosternal apophysis absent. Sides of pronotum less rounded and less narrowed towards posterior angles; base almost straight, with only a slight indication of a median emargination; median convexity more raised

on disc, interrupting more broadly the transverse impression of middle; episternum of prosternum much more densely granulate than the prosternum itself (showing the same sparse granulation as on prosternum in *nigrosetosa*).

The elytra appear as if shoulderless, but in fact there are short, obliquely sloping shoulders, which are minutely demarcated from lateral outlines of elytra; basal surface distinctly impressed between humeral margin and the slightly raised discal portion; punctation less foveate, finer, with the granules on intervals becoming denser and more dentiform towards sides; there are no dorsal ridges, and a lateral edge is indicated only along humeral portion; pilosity a little longer and distinctly paler, of a light reddish tint; punctation on reflected portions less coarse; the lateral contours, viewed from above, appear as if very finely denticulate; apical declivity less steep and obliquely sloping towards apex. Pilosity of elytral and pronotal bases sparser and not brush-like.

Dimensions: Length  $9\frac{1}{2}$  to 10 mm., width  $4\frac{3}{4}$  to 5 mm., height  $3\frac{3}{4}$  to 4 mm.

Locality: Belgian Congo: Sandoa, June 1932, leg. G.F. Overlaet (14 spec., holo- and allotype in B.C.M., paratypes in B.C.M. and T.M.).

Systematic position: The new species, occurring together with *nigrosetosa* subsp. *sandoana* at the same locality, seems to be more differentiated from this species than from *bechuana* Hesse. Although it has a striking resemblance with *bechuana*, the latter is well distinguished from the new one as follows:

Third joint of antennae less abbreviate, one-third longer than broad, about as long as basal joint or apical one (in *brevicornis* only a little longer than broad, and distinctly shorter than the basal joint and much shorter than the apical one). Submentum with a characteristic, widely meshed reticulation (irregularly granular in *brevicornis*, as in *nigrosetosa*). Intercoxal process of basal sternite of abdomen narrower than submentum (in *brevicornis*, as in *nigrosetosa*, almost as broad as submentum). There are no shoulders indicated, the secondary pilosity on elytra is denser, the primary granules are less dentiform and the pilosity of body is paler.

Further species, having an abbreviate third joint of antennae, are the two East African *costata* Geb. and *seriepilosa* Geb. *P. costata* is well characterized by the much smaller size, the quite different shape of body, and the decidedly costate elytra, whereas *P. seriepilosa* is easily distinguished from the new species by the conglomerated granulation on the strong median convexity of pronotum, the different sculpture of elytra, and the subdentate inner angle of anterior emargination of pronotum.



**Pogonobasis (s. str.) distincta n. sp.**

(Plate VII, fig. 150)

Black, palpi reddish; dull; pilose. Head above covered with a dense and shallow rugose sculpture, scattered only on supra-antennal portions. Pilosity sparse, rather long, adherent, of a reddish yellow colour. Median teeth of epistomal emargination minute. Supra-antennal portions strongly raised, with slightly sinuate lateral contours. Pre-ocular grooves large and deep, with smoothed background. Supra-orbital ridges faintly developed, obliquely prolonged towards middle of vertex. Submentum subcarinate apically. Apical margin of buccal fissure lobes only very slightly triangular. Antennae stout and short, slightly accrescent towards apex; basal joint, viewed from the side, nearly twice as long as third joint; the latter about as long as broad, hardly longer than second joint and distinctly longer than fourth joint, much shorter than the two following joints combined; all the following joints transverse, with the two pre-apical joints about twice as broad as long; apical joint large, almost as long as the two previous joints taken together, and much longer than third joint. Pronotum a little more than twice as broad as head, broadest behind middle, there about three times as broad as long. Base of anterior emargination straight, one and a half times as long as pronotum at midline, and a little more than four times as long as inner lateral margin; the latter separated from base of emargination by a large semi-circular incision. Sides obsoletely and irregularly denticulate, rounded and dilated from anterior angles towards middle, shortly and slightly narrowed towards base, in front of posterior angles practically subparallel. Anterior angles obtusely rectangular, the posterior ones nearly rectangular. Base almost straight, sometimes slightly sinuate at each side of the very slightly produced middle. Disc at each side of the comparatively strong median convexity with a transverse impression at middle; the median convexity with a faint, sometimes hardly indicated sulcus along midline, covered with many elevate primary granules, which have the tendency of becoming confluent longitudinally and forming some irregular, short and wavy ridges; remaining surface with a few primary granules, intermixed with some smaller secondary ones. Lateral portions moderately raised. Pilosity of a reddish yellow tint, sparse and semi-erect on surface, long and brush-like on anterior margin and base; the hairs on lateral edge very short and bristle-like. Background of prosternum densely covered with a fine microgranulation, and some larger primary granules, which become transversely confluent and rugose discally; episternum sparsely granulate; the sparse and short pilosity becoming longer and more concentrated on intercoxal apophysis. Basal surface of prothorax, examined in sectional view, inermous. Elytra shoulderless, broadest behind middle, there distinctly broader than

pronotum, with the base much narrower than that of pronotum. Sides rounded and strongly dilated from base towards broadest point; in dorsal view, appearing as if strongly denticulate. Basal surface evenly convex. Apical declivity high and rotundate, steep and almost perpendicular in front of apex. Suture and two discal ridges raised on each elytron; the discal ridges and the lateral margin composed of larger, somewhat dentiform granules, the sutural interval covered with a dense and fine secondary granulation; the two dorsal intervals, between suture and inner ridge and between the two discal ridges, covered with coarse, dense and foveate punctures, more or less distinctly arranged in three longitudinal rows on each interval; the intervening spaces between punctures transversely confluent, and a little smaller than diameter of punctures, covered with very sparse, fine granules; from the outer ridge towards lateral margin the sculpture becomes more irregular, with the spaces between the evanescent punctures raised to numerous dentiform granules. Pilosity of a reddish yellow to a pale reddish brown colour; longer and dense on suture, the two dorsal ridges and along lateral margin, shorter and sparse on intervals; the brush-like pilosity of base of an intense orange. Reflected portion with less dense foveate punctures; the intervals between punctures partly larger than the diameter of punctures, and sparsely covered with fine granules. Underside of afterbody with rather dense and fine setiferous punctation. Intercoxal process of basal sternite of abdomen very broad, truncate, distinctly broader than the submentum. Legs slender; bristles of tibial edges reddish yellow; basal joint of posterior tarsi distinctly shorter than ungual joint.

Dimensions: Length 9 to 11 mm., width 5 to 5 1/2 mm., height 3 1/2 to 3 3/4 mm.

Localities: Belgian Congo: Kapanga (Lulua), September 1932, leg. G.F. Overlaet (10 spec., holo- and allotype in B.C.M., paratypes in B.C.M. and T.M.); Sandoa, July and October 1931-1932, leg. G.F. Overlaet (10 paratypes, B.C.M.); Bambesa, 8 July 1937, leg. J. Vrydagh (1 paratype, B.C.M.); Kafakumba, December 1930, leg. G.F. Overlaet (1 paratype, B.C.M.); Lukoshi-Luco (Luashi), November 1937, leg. F. Freyne (3 paratypes, B.C.M.); Lulua: Luashi, 1936, leg. F. Freyne (3 paratypes, B.C.M.).

Systematic position: *P. distincta* is another new species of the shoulderless *Pogonobasis*, having an abbreviate third joint of antennae. Owing to the strongly raised median convexity of pronotum and the conglomerated and rather coarse granulation on this convexity, it seems to be related only to *P. seriepilosa*. The latter is easily distinguished from the new species as follows:

Size larger, 10 1/2 to 13 mm. long.

Apical margin of buccal fissure lobes distinctly triangular.

Antennae less incrassate.

Pronotum broadest at middle, there only two and a half times as broad as long; sides strongly rounded and narrowed towards base and not sub-parallel in front of the latter; posterior angles obtuse; lateral part of anterior emargination forming a somewhat dentiform angle, projecting inwards beyond the semi-circular incision at base; base straight; the conglomerated granules on median convexity well separated; prosternal apophysis even and granulate dorsally, without median sulcus on top, densely pilose on apical declivity.

Elytra less broad and longer, with the hairs on suture, the two dorsal ridges and lateral margin longer and of a whitish yellow colour; dentate primary granules, as well as dorsal ridges less strongly developed; intercoxal process of basal sternite of abdomen broader.

*P. rhodesiana* Hesse, which shows similar proportions of the antennal joints, differs considerably from the new species, in the continuous and not interrupted transverse impression on pronotum; the latter is much broader, it lacks the conglomerated granulation on middle, and the sides are strongly rounded and narrowed towards the obtuse posterior angles; pilosity on upper surface whitish yellow.

***Pogonobasis* (s. str.) *senegalensis* n. sp.**

(Plate VI, fig. 147)

The new species resembles to a high extent the common *rugulosa* Guérin, with which it occurs together. It is sharply distinguishable from this species in the following particulars.

The sculpture on head is very peculiar and different from all the other *Pogonobasis*, except for another new species from the same region, viz., *P. opatra* n.; it is composed of sparse, well separated fine granules, still more scattered on inter-ocular space; from these granules originate long, semi-erect yellowish hairs. In *rugulosa* the upper surface of head shows the usual sculpture, formed by dense, granular, irregularly confluent rugosities; the sculpture on inter-ocular space is hardly sparser than on remaining surface; the bristles are shorter and practically adherent.

The sinuosity of the lateral outlines of supra-antennal portions is very strong, sometimes almost angular (slight and rounded in *rugulosa*); supra-antennal portions more strongly raised; supra-orbital ridges shorter and more oblique. Antennae more incrassate, covered with a darker pilosity of a red to brownish tint; third joint only one and a third times as long as broad, much shorter than the two following joints combined; fourth joint a little longer than broad; the following joints transverse, becoming gradually broader towards apex, with the fifth joint a little broader than long, and the two

pre-apical joints one and a half times as broad as long; apical joint distinctly longer than third one. *Rugulosa* belongs to the *ornata*-group, which is distinguished by the comparatively slender antennae; in *rugulosa* the pilosity is of a whitish yellow colour; third joint twice as long as broad, nearly as long as the two following joints combined; fourth joint distinctly longer than broad; fifth joint square; the following joints do not become broader towards apex, remaining slightly broader than long, with the two penultimate joints one-quarter to one-third broader than long; apical joint much shorter than the elongate third joint.

Elytra a little longer, more convex, with the sides more narrowed towards base; pilosity darker, of a pale reddish brown (reddish yellow in *rugulosa*). Epipleural carina strong (weak in *rugulosa*).

Bristles on tibial edges darker and not reddish yellow as in *rugulosa*.

Dimensions: Length  $8\frac{1}{4}$  to  $10\frac{1}{2}$  mm., width  $4\frac{1}{4}$  to  $5\frac{1}{4}$  mm., height  $3\frac{1}{4}$  to  $3\frac{1}{2}$  mm.

Localities: Senegal: M'Bambey, 9 to 15 April 1940, leg. M. Risbec (6 spec., holo- and allotype in B.C.M., paratypes in T.M.); French Sudan: Upper Volta, Pundu, leg. Olsufieff (45 paratypes in Z.St.S. and T.M.).

Systematic position: The new species agrees very well with *P. rugulosa* in the remaining particulars, i.e.: the strongly transverse pronotum, which is almost unsculptured, smooth on upper surface, very sparsely granulate on underside, having subparallel sides in front of posterior angles; the densely pilose apical declivity of prosternal apophysis; the shiny elytra, which are coarsely but not foveately punctured, with the intervals between punctures larger than the diameter of punctures; the narrow intercoxal process of basal sternite of abdomen; and the elongate basal joint of posterior tarsi, being longer than the ungual joint.

From the East African *P. cognata* Lesne, the new species is easily distinguished, apart from the peculiar sculpture on head, in the smooth and also apically not denticulate lateral contours of elytra, and the absence of any lateral margination of the latter.

The new species differs furthermore from *P. ornata* Sol. practically in the same way as *rugulosa*. The shape of body is much broader; the lateral surfaces of pronotum are much more developed and broader (very narrow in *ornata*); the upper surface of pronotum is almost unsculptured (distinctly granulate in *ornata*); the broad elytra, which are only a little broader than pronotum, showing an evenly convex basal surface (in *ornata* they are broader than pronotum, and the basal surface is distinctly impressed along suture and humeral margin). *P. senegalensis* can not be confused with *P. Raffrayi* Haag, apart from the completely different build of body and an-



tenuae, on account of the inermous basal surface of pronotum, which, in *Raffrayi*, is distinctly bidentate or bituberculate, when examined in sectional view.

**Pogonobasis (s. str.) opatra n. sp.**

The new species is closely related to *P. verrucosa* Erichs., representing the most northern form and at the same time the most reduced sculptural phase of the phylogenetic line *verrucosa-similis*. It is distinguishable from *verrucosa* and *similis* Hesse in the following particulars.

Shoulders well pronounced, but obtusangular (almost rectangular in *verrucosa*). The elytra are uniformly convex, without any discal ridges; their sculpture consists of a comparatively fine punctation, which is still finer than that in *verrucosa*, and on the large intervals between punctures of a very scattered and fine setiferous granulation, intermixed with some slightly larger but not dentiform granules on sides; viewed from above, the lateral contours appear as if smooth, sometimes minutely denticulate only along the slightly caudate apex; in caudal aspect, the surface appears to be covered with a rather dense and short bristle-like pilosity between the hairs of the primary granules, which are a little longer. Punctation on reflected portions extremely sparse, fine and tending to become evanescent (dense and very coarse in the two compared species).

Disc of pronotum almost smooth, without distinct granules (granulate in the compared species).

The rugose sculpture on head, above and below, is more granular and very scattered, reduced to a few granules on inter-ocular space of vertex in the compared species the head is very densely sculptured altogether).

Legs and antennae a little more slender, but showing the same proportions of joints as in the compared species.

Dimensions: Length  $10 \frac{1}{4}$  to  $11 \frac{1}{2}$  mm., width  $5 \frac{3}{4}$  to 6 mm.

Localities: Senegal: M'Bambey, 18 October to 6 November 1939, leg. M. Risbec (2 spec., holotype, sex not determined, in B.C.M., paratype in T.M.); Senegal, ex coll. Mouflet and Baden (6 paratypes in Z.St.S. and T.M.).

Systematic position: As the three species *verrucosa*, *similis* and *opatra* are extremely similar to one another, I like to indicate also the particulars, by which *verrucosa* is distinguished from *similis*.

The punctation on elytra is much finer, not foveate, with the intervals between punctures larger than the diameter of punctures and covered with many very fine setiferous granules; viewed from behind, the elytra show a dense, erect and very short bristle-like pilosity between the longitudinal rows of the longer primary hairs; the dentiform primary granules are less developed and do not form two distinct dorsal ridges; the lateral contours, viewed from

above, appear as if very finely and irregularly denticulate. In *similis* the punctation on elytra is very coarse and foveate, with the intervals between punctures distinctly smaller than the diameter of punctures, forming a kind of reticulation, and very sparsely covered with fine granules; in caudal aspect, the short and bristle-like pilosity on intervals, between the rows of long primary hairs, appears to be very scattered; the dentiform primary granules are well developed, sharply pointed and more numerous, forming two distinct dorsal ridges on each elytron; the lateral contours, viewed from above, appear as if strongly and densely denticulate.

The antennae are a little longer; basal joint distinctly shorter than third one; the latter more elongate, about one and a half times as long as broad, a little shorter than the two following joints combined, and longer than the apical joint. In *similis* the basal joint is a little longer than the third joint; the latter only one and a third times as long as broad, comparatively much shorter than the two following joints combined, and distinctly shorter than the apical joint. In most of the other particulars, however, the two species agree very well; they are identical in the broadly rounded shoulders, the triangular apical margin of buccal fissure lobes, shape and sculpture of head and pronotum, the narrow intercoxal process of basal sternite of abdomen, the elongate basal joint of posterior tarsi and the widely meshed reticulation on submentum.

*Verrucosa* Er. occurs in Northern Angola and in the south-western part of the Belgian Congo; from *P. similis* I was able to examine a long typical series from the northern Bechuanaland (T.M.).

*P. opatra* occurs together with *P. rugulosa* and *senegalensis* at M'Bambey; it differs from *rugulosa* in the strongly transverse pre-apical joints of antennae, from *senegalensis* (with which it agrees most strikingly in the scattered sculpture on head and in the formation of antennae) by the yellowish pilosity of antennae (of a dark red in *senegalensis*), the less sinuate lateral contours of supra-antennal portions, the widely reticulate sculpture on submentum (sparsely granulate in *senegalensis*), the much broader build of body, and the dull and more convex, differently sculptured elytra, which furthermore show a quite different, much denser and bristle-like pilosity.

***Prunaspila carinicollis* n. sp.**

(Plate VII, fig. 153)

Body black, with remainders of a whitish blue pruinescence, apical joint of antennae and tarsi reddish brown; dull; bare. Head densely covered with somewhat elongate granules, becoming more concentrated on supra-antennal convexities and vertex, well separated and round on the more shiny epistomal surface. Median teeth of epistomal emargination prominent, but

minute. Supra-orbital ridges moderate. Pre-ocular groove elongate and deep. Labrum shiny, reddish, cirrous apically. Submentum transverse, twice as broad as long, densely granular, emarginate at middle of apical margin. Buccal fissure lobes large; projecting beyond apical margin of submentum, rugosely punctured and subgranular, with triangular apical margin. Antennae strongly compressed; basal joint short, about as long as the fourth joint second joint the shortest, strongly transverse; third joint the longest, more than twice as long as the previous joint, almost two and a half times as long as broad; the following intermediate joints transverse; the apical joint very large, almost as long as the two previous joints taken together, with large sclerotized basal part and small sensorial part apically. Pronotum strongly transverse, broadest behind middle, there one and a half times as broad as head, more than twice as broad as long, with strongly convex discal part and foliaceous, concave lateral portions. Sides with fine denticulation, strongly and almost straightly dilated from anterior angles to middle, there subangulate, thence rounded and strongly narrowed towards base. The latter straight or very slightly emarginate, much narrower than anterior margin, with obtuse posterior angles. Discal convexity with a complete and sharp median carina; each side of the latter transversely impressed; the median carina coalescent with the slightly raised and somewhat thickened carina of anterior margin. Lateral edges distinctly bent upwards. Integument covered with fine granules or rugosities on disc, with very scattered and fine granules on lateral portions. Prosternum sparsely granulate, with a row of fine and dense granules along anterior margin; intercoxal apophysis short, spoon-like, abruptly and perpendicularly declivous apically; episternum with shallow antennal sulcus at midline, with a few fine granules on sloping inner portion, densely granulate on foliaceous outer portion. Elytra broadly oval, broadest at middle, there about one-quarter broader than pronotum, strongly narrowed towards base. The latter as broad as pronotal base. Each elytron with a highly raised median costa, which is more approximate to sides than to suture, slightly crenulate on top, running parallel with the lateral outlines of elytra, reaching the base, converging towards suture apically, and in front of apex parallel with suture, becoming obsolete on apical declivity. Discal portion, between median costae, slightly concave, with the suture faintly raised. Integument uniformly covered with a rather scattered fine granulation, and with the background between granules obsoletely foveate-punctate; along suture the granules arranged in a longitudinal row on each elytron. Lateral portions strongly rotundate and, without forming a lateral edge, continuous with reflected portions; between median costa and lateral contours with a very slightly indicated longitudinal row of granules, more obvious posteriorly; granules on lateral portions very dense, fine and pointed, some-

what dentate. Apical declivity steep, almost perpendicular. Sides subparallel at middle, strongly narrowed towards base and apex. Mesosternal apophysis hardly broader than prosternal one, and densely covered with round and larger granules; remaining parts of underside rather densely covered with fine and setiferous granules, most concentrated on anal sternite of abdomen. Legs slender, shaped as in all the other *Prunaspila*.

Dimensions: Length  $7\frac{1}{2}$  to  $7\frac{3}{4}$  mm., width  $3\frac{1}{2}$  to  $3\frac{3}{4}$  mm.

Locality: Northern Transvaal, North-East Zoutpansberg district, July and August 1916, leg. H.G. Breyer (8 spec., holo- and allotype in T.M., paratypes in T.M. and B.C.M.).

Systematic position: The new species is easily distinguished by the median costa on pronotum, lacking all the other species. For further details see key.

#### KEY TO THE SPECIES OF *PRUNASPILA* KOCH

- 1 Antennae short; third joint much shorter than the two following joints taken together, about as long as basal joint or the apical one. Sides of pronotum strongly narrowed and rounded towards base, meeting the dentiform posterior angles at an obtuse angle. Pronotum slender, only one and a half times as broad as head (cf. plate VII, fig. 155). ..... ***P. Arnoldi* n. sp.**

*P. Arnoldi* is closely related only to *P. bicostata* (Fahr.), with which it agrees well in sculpture and build of body; it differs from this species, apart from the particulars, mentioned in the key, in the absence of a median carina on head, the more slender and basally more constricted elytra, and the discally more densely granulate pronotum, which shows deeper lateral incisions of base, with the dentiform posterior angles strongly produced backwards.

The inferior carina of prothoracic base, examined in sectional view, is separated from foraminal margination.

Dimensions: Length  $6\frac{1}{2}$  to 8 mm., width 3 to  $3\frac{3}{4}$  mm.

Localities: Southern Rhodesia: Penkridge, 10 September 1927, leg. R.H.R. Stevenson (1 spec., holotype, sex not determined, in T.M.); same locality, 9 February 1928, leg. R.H.R. Stevenson (3 paratypes in National Museum, Southern Rhodesia); Birchenough Bridge, January 1936, leg. G. van Son (3 paratypes in T.M.).

I have named the new species in honour of Dr. G. Arnold, Director of the National Museum of Southern Rhodesia, Bulawayo.

- Antennae long; third joint as long as the following joints taken together, longer than basal joint and considerably longer than the apical one. Sides of pronotum abruptly and angularly narrowed towards base,



- running in almost the same transverse direction as the base itself in front of posterior angles, without forming any angle at all at the point of contact with the posterior angles of pronotum; the latter broad, twice as broad as head or broader. .... 2
- 2 Pronotum with strongly raised and sharp median carina, with the sides continuous with base, without posterior angles and without lateral incisions of base. Elytra without lateral edge, their dorsal surface continuously rotundate with reflected portions; only the inner dorsal ridge well developed, the outer one faintly indicated apically; reflected portions with fine granular sculpture, intermixed with obsolete punctures. Antennae slender; third joint a little longer than the two following joints combined; fourth one a little longer than broad (cf. plate VII, fig. 153). .... **P. carinicollis Koch, supra cit.**
- Northern Transvaal: North-East Zoutpansberg district.
- Pronotum without median carina; sides variously shaped, but with the posterior angles always well pronounced, because of a minute to semi-circular incision of base, situated each side of posterior angles. Elytra with sharp and prominent lateral edge; both dorsal ridges sharp and subcostate; reflected portions with coarse, almost foveate and dense punctation. Antennae stout; third joint exactly as long as the two following joints combined or a trifle shorter; fourth joint square to slightly transverse. .... 3
- 3 Elytra covered with scattered, fine, very long and erect hairs; dorsal ridges carinate but not costate, separated and not coalescent apically (cf. fig. 101) with the intervals between ridges flat and not concave; apical declivity obliquely sloping towards apex; apical part of epipleural carina connected with the stridulatory carina by a slightly convex impunctate line. Middle of vertex with a sharp and short carinula anteriorly. Base of pronotum with rather large semi-circular incisions inwards from the dentiformly produced posterior angles. Size larger: 7 to 9 mm. long, 3 3/4 to 4 3/4 mm. broad (cf. plate VII, fig. 156). ... **P. bicostata (Fabr., 1870)**

The holotype of *Aspila Dohrni* Haag, 1876 (ex Z.St.S.) (cf. plate II, fig. 99) does not differ specifically from the holotype of *Aspila bicostata* Fabr. (ex Nat. Riksmuseum, Stockholm); the shape of body is broader, and the sculpture of upper surface is somewhat coarser than in *bicostata*; as all possible transitional forms exist between the two forms, I consider *Dohrni* to be a simple synonym, or 'at most a forma of *bicostata*.

The species is very variable in the width of body and development of the shoulders. The inferior carina of the basal surface of prothorax, examined in sectional view, is obsoletely extended to foraminal margins.

Localities : Northern Transvaal : Leipzig, Blaauwberg, 17 January 1931, leg. G. van Son (3 spec., T.M.); Mokala, April 1903, leg. A.J.T. Janse (1 spec., T.M.); Futie, Zoutpansberg district, 30 July 1949, leg. University California-Transvaal Museum Expedition (56 spec., T.M.); Salt Pan, Zoutpansberg district, 26 July 1949, leg. University California-Transvaal Museum-Expedition (27 spec., C.A.Sc.); Zoutpan, East of Pretoria, 9 December 1926, leg. G. van Son (2 spec., T.M.). — Griqualand West : Kimberley <sup>(8)</sup>, 5 February 1951, leg. F.J. Marais (1 spec., McGregor Museum, Kimberley). — Portuguese East Africa.

- Elytra bare; dorsal ridges and lateral edge strongly costate; apically either all ridges, the lateral edge included, coalescent, or only the two dorsal ones, or only the humeral ridge with the lateral edge (cf. plate II, fig. 100); intervals between ridges concave; apical declivity perpendicular; between epipleural carinula and stridulatory carina no connecting line. Vertex without carina. Base of pronotum with minute, hardly perceptible incision inwards from the minutely prominent posterior angles. Size smaller : 6 to 7 1/2 mm. long, 3 to 3 3/4 mm. broad (cf. plate VII, fig. 154). ..... **P. transvaalensis n. sp.**

Localities : Northern Transvaal : Grootdraai, Oliphants River (Kruger National Park), October 1927, leg. H. Lang (8 spec., holotype, sex not determined, in T.M., paratypes in T.M. and B.C.M.); Illangane River (Kruger National Park), September 1932, leg. H. Lang (7 paratypes in T.M.); Letaba (Kruger National Park), 20 September 1932 (5 paratypes, T.M.); Sokolumi (Kruger National Park), 1932, leg. H. Lang (2 paratypes, T.M.); Pundamaria (Kruger National Park), November 1932, leg. H. Lang (1 paratype, T.M.); Zoutpansberg district, 6 July 1917, leg. H.A. Breyer (8 paratypes, T.M.); Lydenburg district, 1896, leg. P.A. Krantz (7 paratypes, T.M.).

#### **Cimiciopsis n. gen.**

Body broadly oval to roundish; faintly convex, complanate, ciliate, dull, blackish to reddish brown. Head transverse, much narrower than prothorax, enclosed in the latter up to about genal angles, with the upper surface flat and covered with obsolete punctures and short yellow bristles. Eyes completely divided by genal canthus; the dorsal part longitudinally reniform, with subparallel lateral margins, and with the inner portion, viewed from

(<sup>8</sup>) The occurrence of this species in Kimberley is very interesting, as the whole genus *Prunaspila* appears to be strictly confined to a comparatively small and rather homogenous area in Southern Rhodesia, northern Transvaal and Portuguese East Africa. Incidentally, I doubted the correctness of this locality, when I first saw two specimens of *bicostata* with the locality labels « Kimberley » in the collection of the Rhodes University, collected by students during the holidays. Actually Mr. F. J. Marais, Zoologist of the McGregor Museum in Kimberley, has incontestably proved this species to occur in Kimberley.

above, partly overlapped by a prominent supra-orbital edge. Epistome emarginate at middle. Labrum normally retracted under epistome, cirrous apically. Mandibles concealed under epistome, with bifid apices. Apical joint of maxillary palpi slender and fusiform. Submentum large, transverse, with the sides straightly narrowed towards truncate base, and with the apical margin emarginate at middle. Buccal fissure lobes large, produced forwards to level with apical margin of submentum, truncate apically. Infra-orbital dilatation covering the ventral part of eyes, separated from genal-gular surface by a shallow longitudinal impression. Gula slightly depressed, delimited laterally by fine and obsolete longitudinal sulci. Antennae shorter than the head is broad, with the basal joint shaft-like and about as long as the two following joints taken together, and with the second joint distinctly longer than the third one; the latter and all the following joints transverse. Prothorax loosely jointed to elytra; basal surface, examined in sectional view, with the inferior carinae of strongly complanate lateral portions being in contact with foramen; the latter large and transversely oval. Pronotum strongly transverse, about three times as broad as long, more than twice as broad as head, a little narrower than elytra, with the base as broad as elytral base, convex discally, and with the lateral portions foliaceous and slightly sloping downwards. There are a shallow longitudinal impression along midline on basal half, a roundish and shallow one at middle each side of midline, and two small, punctiform foveae, each of them situated a little behind middle at about the inner margin of the foliaceous lateral portions. Anterior margin much narrower than base, broadly emarginate and with strongly produced lobiform lateral portions; base of emargination furnished with a fringe of dense yellowish to golden hairs. Sides serrate-denticulate, ciliate, slightly rounded and strongly dilated to base. The latter with the middle slightly produced backwards, rounded and with a dense fringe of yellowish hairs; lateral parts obliquely straight, serrate-denticulate and ciliate. Posterior angles obtusely rounded. Integument sparsely sculptured. Prosternal apophysis spoon-like, gradually curved downwards, but projecting beyond outlines of procoxal cavities. Antennal sulcus on episternum of prosternum very shallow, open apically, with small fovea opposite the lateral fovea on upper surface of pronotum. Elytra broad, with the sides strongly rounded, ciliate, denticulate or granular; with a subcarinate humeral row of granules, running parallel with the lateral crest of elytra. Integument covered with moderately dense, fine setiferous granules, which are irregularly set, except for a fine longitudinal row along midline of each elytron. Base widely separated from prothorax, with more or less pronounced humeral angles. Scutellum large, triangular. Apical declivity short, but rather steep, without caudate lobe apically. Reflected portions very broad, embracing

abdomen, sparsely punctured, on apical quarter with silken yellowish cilia; with a short and oblique stridulatory carina on basal half, superficially connected by a smooth line with the epipleural carinula, confined to the apex of elytra. Basal part of mesosternum with small median carina; intercoxal apophysis impressed along midline. Metasternum short, about as long as second sternite of abdomen, distinctly shorter than first one; discal portion slightly raised and flattened; apical margin emarginate at middle; episternum about as broad as the sloping lateral portions of metasternum, or as broad as the bordering epipleural space. Abdomen flat, covered with sparse and setiferous punctures; intercoxal process of basal sternite broad, rounded apically. Legs slender, pilose. Femora slightly compressed, with flattened or slightly concave underside. Tibiae spinose on outer surface, faintly dilated towards apex; anterior tibiae with the apical margin as broad as the three proximal joints of anterior tarsi are long together; calcares prolonged, with the longer spur of intermediate or posterior tibiae about as long as the two proximal joints of the respective tarsi are long together, and distinctly longer than claws. Tarsi short, hardly compressed, pilose above, spinose underneath; ungual joint longer than basal joint; the proximal joints of anterior tarsi transverse, those of posterior tarsi more elongate.

Type species: *Cimiciopsis Castleae* n. sp.

***Cimiciopsis Castleae* n. sp.**

(Plate II, fig. 97; Plate VIII, fig. 157)

Body broadly rounded, flat, reddish brown, dull, pilose, ciliate at sides.

Head above covered with shallow punctures, from which originate short, yellow and semi-erect bristles. Epistomal surface with extremely fine, hardly perceptible median carinula; emargination of epistome shallow, with a faintly projecting and minute tooth at each side of middle. Supra-orbital portions dilated, rounded laterally and slightly bent upwards. Genal outlines straight, strongly dilated towards epistomal angles; lateral outlines of epistome a little longer than genal ones, strongly narrowed towards apical margin of epistome. Underside sparsely covered with short adherent yellowish bristles. Antennae short; basal joint the longest, distinctly longer than apical joint, thicker and longer than the very small intermediate joints; second joint a little longer than broad, longer than the following joints; third joint hardly longer than the fourth one, slightly transverse; fourth and fifth joints strongly transverse; the following joints becoming slightly and gradually narrower towards apex, with the distal joints a little smaller than the proximal ones; apical joint large, a little longer than the two previous joints taken together, with the apical margin of the sclerotized part produced into a slightly pointed angle on compressed surfaces. Pronotum broadest at base, there more than twice



as broad as head, and three and a half times as broad as long, with the sides and around angles sharply serrate-denticulate. The deep and broad emargination of anterior margin with a small incision between base and inner lateral margins. The convex discal portion with obsolete punctation, changing into sparse granules towards anterior margin; along the straight base of anterior emargination with a row of dense, fine and subdentate granules; foliaceous lateral surfaces with very scattered and fine granules, bearing the same semi-erect short pilosity as on disc. All borders ciliate. Prosternum and inner part of episternum punctured and covered with sparse, adherent yellowish bristles, concentrated on intercoxal apophysis; some space from anterior margin of prosternum, and parallel with it, runs a narrow, bare and transverse line across the entire convex portion of prothorax below; antennal sulcus smooth; foliaceous parts of episternum with a few fine and setiferous granules. Elytra broadest before middle, there a little broader than pronotum, and only a little broader than long, roundish, with the sides faintly narrowed towards base, strongly rounded and narrowed towards apex; slightly convex. Base slightly emarginate along mesothoracic tergite, with the lateral portions obliquely cut off and meeting the rounded sides in an obtuse humeral angle. Sides with a sharp, regularly denticulate crest, entirely visible from above, and continuous with a finely granulate crest on the obliquely sloping lateral parts of base; parallel with the lateral crest there is a similarly serrate-denticulate, slightly curved humeral row, running in a short distance from the lateral edge, and ending about on top of the apical declivity; the space between suture and humeral crest, measured across middle of each elytron, is seven to eight times as broad as the lateral interval between humeral crest and the lateral one. The disc between humeral crests is covered with moderately dense and irregular, shallow punctures, from which emerge short and erect yellowish bristles; a longitudinal row of punctures can be observed along the little obvious suture and along midline of each elytron; the lateral interval is covered with scattered, fine granules, bearing the lateral cilia. Apical declivity short, but rather steep, with the extreme apex faintly caudate. Reflected portion flat, with irregular and fine punctation, changing into fine, ciliate granules towards sides and apex, with two rows of coarse punctures on epipleural space along elytral margin. Metasternum and the three first sternites of abdomen with rather dense, setiferous punctation on disc, very scattered laterally; the two apical sternites with dense setiferous punctures throughout. Legs as indicated in generic description.

Dimensions: Length 5 to 5 1/2 mm., width 3 1/2 to 3 3/4 mm.

Localities: South-western Great Namaqualand: Chameis, 9 December 1948, leg. University California-Transvaal Museum Expedition (1

spec., holotype, sex not determined, in T.M.); 30 miles North of Chameis; 13 November 1949, leg. C. Koch (3 paratypes in T.M. and B.C.M.).

Habitat: Collected in cracks of limestone outcrops in the coastal steppe of the Southern Namib.

I have much pleasure to dedicate the new species to Miss Gwendoline Joan Castle, Secretary to the General Manager of the Consolidated Diamond Mines of South West Africa, at Lüderitzbucht.

Systematic position: See key to genera. The new species recalls *Cimicia spinipes* Fairm., in showing some convergent characters as the ciliation of sides of body, the rounded shape of the latter, and the strongly prolonged tibial calcares.

***Cimiciopsis atra* n. sp.**

Specifically differing from *C. Castleae* as follows:

Body black, partly blackish brown, more slender, smaller, with longer cilia at sides. Epistomal emargination broader and deeper, with two distinct teeth at middle. Median carina on forehead absent. Supra-orbital ridges very small, less raised and less dilated above eyes. Integument between adherent bristles with a few long and erect hairs; underside of head with finer sculpture. Antennae shorter; basal joint comparatively longer; second joint a little longer than third joint; the latter broader than long and slightly longer than fourth joint; the following intermediate joints, fourth one included, strongly transverse, about twice as broad as long, and not becoming attenuate towards apex; apical joint a little longer than the two previous joints combined, with the apical margin of the sclerotized portion hardly angulate. Pronotum not quite three times as broad as long, with the anterior angles more or less rectangular and not rounded as in *Castleae*; base of anterior emargination shorter and demarcated from inner lateral margins by a short right angle. Lateral edge with less sharp and much finer denticulation, with much longer cilia. Oblique lateral portions of base faintly sinuate at each side of median lobe. The granular row along base of anterior emargination extremely fine, little obvious and not serrate. Pilosity of integument adherent. Antennal sulcus on episternum of prosternum deeper. Elytra distinctly longer than broad, broadly oval, more convex, with longer cilia at sides, and with the adherent bristles on disc inclined backwards. Humeral and lateral crests faintly pronounced, composed of very fine and pointed granules, not serrate-denticulate as in *Castleae*; lateral space between humeral row and lateral edge more strongly, almost perpendicularly declivous, broadened apically, punctured and not granulate. The median rows with coarser and deeper punctures, with the discal space between those rows hardly convex. Humeral angles more rounded, with the lateral parts of base without distinct crest.

Calcares of intermediate and posterior tibiae a little longer; apical angle of the outer margin of tibiae more distinctly produced outwards.

Dimensions: Length  $4\frac{1}{2}$  to 5 mm., width  $2\frac{1}{2}$  mm.

Locality: North-western part of Little Namaqualand: Port Nolloth, 22 November 1948, leg. University California-Transvaal Museum Expedition (1 spec., holotype, sex not determined, in T.M.); same locality, 2 September 1950, leg. C. Koch and G. van Son (1 paratype in T.M.).

Habitat: Deep in the sand of the white littoral dunes, between the roots of grasses.

**Smiliophanus Vansonii n. sp.**

(Plate VIII, fig. 160)

The new species, which agrees much with the holotype of *S. steiroides* (Haag) (cf. plate VIII, fig. 159) in the sculpture and shape of body, is easily distinguished as follows:

Body more slender. Head as in *steiroides*, but the dorsal part of eyes larger, the median carinula on fore-head very short and weakly pronounced, and the apical margin of buccal fissure lobes straight (very slightly rounded in *steiroides*). Antennae very different; more slender, covered with extremely short and scattered, little obvious bristles of a whitish yellow tint; not attenuate towards apex; but of equal thickness, except for the broadened apical joint; second joint basally with strong emargination at inner margin, with the subparallel outer margin distinctly longer than subparallel part of inner margin, square to slightly longer than broad; third joint elongate, one and a half times as long as broad, only a little shorter than basal joint and practically the length of apical joint; the following intermediate joints less transverse, about two-thirds broader than long, in exact lateral aspect of equal width; apical joint distinctly broader than third joint, and about one-third longer than broad (in *steiroides* the antennae are much stouter, densely covered with comparatively long bristles of an intense reddish yellow colour, attenuate towards apex; second joint with hardly perceptible basal emargination at inner margin, with the latter as long as outer margin, strongly transverse, twice as broad as long; third joint short, one and a third times as broad as long, much shorter than basal joint or the apical one; the following intermediate joints, strongly transverse, well two and a half times as broad as long, and also in exact lateral view becoming distinctly attenuate towards apex, with the pre-apical joints therefore considerably less broad than the proximal ones; apical joint a little narrower than third joint, and about square). Prothorax as in *steiroides*, except for the median sulcus on pronotum, which is deeper and more distinctly separated from the lateral impressions by more elevated, subcariniform convexities in between. Elytra shaped

and sculptured exactly as in *steiroides*. Posterior portion of body below and legs as in *steiroides*, except for the tibiae, which are a little less broadened.

Dimensions : Length 7 mm., width  $2\frac{3}{4}$ , almost 3 mm.

Locality : Little Namaqualand : Van Rhynsdorp, July to August 1927, leg. G. van Son (1 spec., holotype, sex not determined, in T.M.).

I have named this very interesting, presumably myrmecophilous species, in honour of its discoverer, Dr. G. van Son, Entomologist to the Transvaal Museum.

***Acestophanus kaokoanus* n. sp.**

(Plate IX, fig. 167)

Very closely related to *A. lanuginosus* (Haag), from whose holotype (ex Nat. Riksmuseum, Stockholm) it differs as follows :

Head as in *lanuginosus*, but with sharp median carina on epistomal surface (absent in *lanuginosus*). Antennae very similar to those in *lanuginosus*, but the third joint distinctly a little shorter than the two following joints taken together, the distal joints six, seven and eight transverse, the ninth joint hardly different in shape and width from the eighth one, and as that a little more than one and a half times as broad as long ; apical joint distinctly longer than the third joint (in *lanuginosus* : third joint exactly as long as the two following joints combined, only the distal joints seven and eight distinctly transverse, the ninth joint larger and longer than the eighth one. apical joint a little shorer than the third one). Pronotum with only a few erect and comparatively short hairs (dense and very long in *lanuginosus*), with the base distinctly broader than anterior margin (as broad as that in *lanuginosus*), with much deeper anterior emargination (shallow in *lanuginosus*), and with the three discal impressions very well pronounced, deep, sub-sulcate, and separated from one another and the slightly concave lateral portions by subcarinate longitudinal convexities (very shallow and only obsoletely defined in *lanuginosus*. Elytra as on pronotum only with a few and short erect hairs (with dense and long hairs in *lanuginosus*) ; the dorsal ridges, as well as the lateral edge very sharp and elevated, costate, with distinctly concave intervals between ridges (fine and only carinate in *lanuginosus*, with flat intervals between ridges) ; apical declivity less steep, exactly perpendicular, in lateral view, shortly and sparsely pilose, with the dorsal ridges and lateral edge projecting beyond the contours of apical declivity (in *lanuginosus* the apical declivity is still steeper, straight and inclined inwards. and, in lateral view, densely covered with a very long and silken pilosity, and showing smooth outlines, as the dorsal ridges and lateral edge do not project beyond contours).

Dimensions : Length 7 mm., width  $2\frac{3}{4}$  mm



Locality : South West Africa, Kaokoveld : Zesfontein, February 1929, leg. Museum Expedition (1 spec., holotype, sex not determined, in South African Museum).

*S. kaokoanus* n., as well as *S. lanuginosus* differ essentially from *S. elongatus* (Haag) (cf. plate IX, fig. 166) in the much more slender shape of body, the discal impressions on pronotum, the very small and little obvious incisions at each side of median portion of pronotal base, the course of the humeral ridge on elytra, the much less broadened tibiae, and the integument of upper surface.

#### **Basilewskyum n. gen.**

Body complanate, subparallel, of *Adelostoma*-like appearance, bare, moderately shiny, black to reddish brown. Head transverse, necked, free and not enclosed in the prothorax. Upper surface densely punctured, transversely impressed in front of eyes, with a slight transverse impression behind, separating the occiput from neck. Epistome emarginate, with the lateral outlines slightly sinuate and broadly rounded with subparallel genae. Genal canthus not completely dividing eyes, with its end narrowed towards posterior margin of eyes. Dorsal part of eyes very narrow, three times as long as broad, slightly oblique and a little overlapped by the short supra-orbital ridge; ventral part large, roundish, compounded of eight to ten rows of corneal facets. Tempora short, subparallel, angularly narrowed towards neck. Mandibles with bifid apex, concealed under epistome. Submentum comparatively small, almost square, slightly emarginate apically, with subparallel sides, which are narrowed in front of the truncate base; separated from the bordering buccal fissure lobes by a deep slit of the mouth cavity, the latter, viewed from the side, with the opening as broad as submentum, and leaving exposed the entire base of mandibles. Buccal fissure lobes short, strongly diverging, extending to a little beyond level with the middle of submentum, and, viewed from above, concealing antennal insertion; inner margin obliquely cut off and forming a sharp dentiform apical angle; outer margin strongly emarginate along eyes. Cervical sulcus complete, slightly impressed. Antennae eleven-jointed, with the eleventh joint rudimentary, very short but well perceptible, annularly inserted into the sensorial part of the large tenth joint; longer than head is broad and extending beyond middle of pronotum, strongly incrassate, subcylindrical, slightly attenuate towards apex, covered with a few very short reddish bristles, with all the intermediate joints pedunculate and strongly transversè; basal joint the longest, only a little shorter than the two following joints combined; second joint simple, not emarginate basally; the large tenth joint shorter than the basal joint, with the apical margin of the sclerotized basal part truncate and furnished with a few very fine and short setae. Prothorax a little broader than head, closely jointed to the elytra.

Pronotum moderately convex, a little broader than long, with slightly rounded sides, shallowly emarginate anterior margin and faintly bisinuate base. Surface with four sharply carinate costae, sharply carinate lateral edges, and with the integument densely and rugosely punctured. Posterior angles rectangular and minutely prominent. Prosternum about twice as broad as long, densely punctured; episternum obliquely sloping towards coxal cavities, with a narrow and horizontally flattened submarginal area along lateral margin, without antennal sulcus; intercoxal apophysis narrow, bent downwards, with perpendicular apical declivity. Elytra subparallel, about two and a half times as long as broad, with distinctly angular shoulders and obliquely sloping, short apical declivity. Each elytron with four sharply carinate dorsal costae and a sharply carinate lateral edge; each of the intervals between costae with two longitudinal rows of coarse, subfoveate punctures, except for the sutural interval, on which the punctation is irregular. Base with fine margination. The lateral edge is formed by the complete epipleural carina, running subparallel and very close to the margin of elytra, becoming slightly and gradually divergent towards base; the inner margination of epipleurae extending from apex of elytra up to level with the apical margin of mesosternal episternum. Epipleural space slightly dilated towards base, becoming very narrow and concave on extreme apex of elytra, sculptured with a longitudinal row of fine punctures. Mesosternum roughly punctured; intercoxal apophysis raised to coxal level, straightly narrowed towards the rounded apex, and not broader than prosternal apophysis. Metasternum very large, one and a half times as long as basal sternite of abdomen, subsulcate along midline, covered with coarse, slightly foveate setiferous punctures; episternum linearly elongate, about five times as long as broad, sharply separated from metasternum by deep sutures, with a longitudinal row of fine and dense, partly confluent punctures along impressed midline. Abdomen convex, punctured, with the three basal sternites becoming gradually and a little shorter towards apex; fourth sternite only about half as long as the previous sternite; anal sternite almost triangular, transversely impressed across middle, a little longer than second sternite; basal sternite with very fine pleural carina, and with the intercoxal process triangularly pointed and narrower than prosternal apophysis. Pro- and mesocoxal cavities roundish, the metacoxal ones transversely oval. Legs stout. Femora slightly compressed, hardly longer than tibiae, deeply sulcate on distal half of underside, and rather sparsely covered with fine setiferous punctures. Tibiae short, with scabrous punctures, almost bare, flattened and slightly sulcate above and underneath, gradually dilated towards apex; the outer contours of anterior tibiae hardly sinuate in front of the sharp and minute apical angle, with the apical margin about as broad as the two proximal joints of anterior tarsi combined; intermediate tibiae

practically straight; posterior ones slightly curved inwards; calcares short, but distinctly longer than the spinulae of coronula, much shorter than the basal joint of the respective tarsi. The latter short, with spinose underside; ungual joint of anterior and intermediate tarsi the longest, that of posterior tarsi hardly longer than basal joint. Claws simple, much longer than tibial calcares.

I have much pleasure to dedicate this very interesting new genus to Mr. P. Basilewsky, Chief Entomologist of the Musée du Congo Belge at Tervuren.

Type species: *Basilewskyum stenosinoide* n. sp.

*Basilewskyum* is the most abnormal genus within the Eurychorini; its systematic position is somewhat intermediate between the Eurychorini and Stenosini, in showing some stenosinoid characters as there are the comparatively small submentum, the more spacious mouth cavity, the eleven-jointed antennae, as well as the structures of the meso- and metasternal pleurites and epipleurae of elytra.

***Basilewskyum stenosinoide* n. sp.**

(Figs. 84, 86; Plate III, fig. 111; Plate X, fig. 172)

Black with the underside of body, legs and the distal portion of antennae reddish brown, and the maxillary palpi testaceous. Head above covered with an extremely dense, slightly confluent round punctation, a little scattered only on supra-antennal portions. Emargination of epistome broad and rounded, without median teeth. Underside, the outer surface of mandibles included, coarsely and densely punctured. Basal joint of antennae one and a half times as long as broad, a little less than twice as long as the second joint; all the following intermediate joints about twice as broad as long; second and third joints of almost the same size, but a little longer than the following joints. Pronotum one and a quarter times as broad as head, broadest at middle, there about one-third broader than long, strongly convex. Anterior angles sharp, slightly produced and rectangular. Sides sharply carinate, slightly rounded and dilated from anterior angles towards middle, rounded but more strongly narrowed towards base, distinctly sinuate in front of posterior angles. Base hardly broader than anterior margin, slightly bisinuate, immarginate, with the lateral angles minutely prominent, rectangular. The two median costae complete, both in contact with the anterior margin and base, subparallel; the two outer costae abbreviate basally and slightly curved inwards; integument on intervals covered with coarse and dense punctures, as on head, the intervening spaces between punctures show the tendency to form a fine median carinula on anterior half of disc. Punctation on prosternum very dense, on episternum coarser and becoming scat-

tered and finally evanescent towards lateral margins. Elytra a little broader than pronotum, with eight sharp and elevate subparallel costae. The inner costa is situated nearer to the second costa than to suture, and ends in front of apex; second costa abbreviate apically and ending a little behind the top of the apical declivity; third costa again prolonged apically and ending very near to the termination of the inner costa; the lateral costa again abbreviate as is the second one; in exact dorsal view, the lateral costa defines sharply the outlines of elytra. Suture carinately raised apically. Epipleural carina strongly developed. Base almost straight, marginate by a fine carinula, which is absent only on lateral interval of each elytron. Integument covered with a rather dense and coarse, irregular punctation on sutural interval, arranged in two longitudinal rows of coarse punctures on the three remaining intervals of each elytron. Underside of afterbody coarsely punctured, becoming slightly elongate on abdominal sternites, except for the anal sternite, which shows a very coarse and round punctation on middle and conglomerated fine punctures along the outer margins (stenosinoid character). Legs as indicated in generic description.

Dimensions: Length  $5\frac{1}{2}$  to 6 mm., width 2 mm., height  $1\frac{1}{4}$  mm.

Locality: Belgian Congo: Bukama, 29 May 1911, leg. J. Bequaert (2 spec., holotype, sex not determined, in B.C.M., paratype in T.M.).

Systematic position: See key to genera. The position of *Basilewskyum* within the Eurychorini is a provisional one, as it is doubtful whether it may belong to the Eurychorini or Stenosini.

***Pearyphulum Machadoi* n. sp.**

(Plate X, fig. 175)

Closely allied to *Ps. abbreviatum* (Haag) (cf. plate X, fig. 177) and distinguishable from it in the following particulars.

Size larger: 5 to  $5\frac{1}{4}$  mm. long,  $1\frac{3}{4}$  to 2 mm. broad.

All elytral costae separated from one another (in *abbreviatum* the first and third costae are coalescent in front of apex of each elytron). Apex of elytra attenuate, strongly caudate and narrowly rounded at the extreme end; apical declivity, viewed from the side, obliquely sloping towards apex (in *abbreviatum* broadly and shortly caudate and broadly rounded at the extreme end; apical declivity almost perpendicular). Integument densely and irregularly granulate, without perceptible punctation (in *abbreviatum* transversely foveate and between punctures with fine granules, which are arranged in longitudinal rows). The subangular dilatation of the sides of pronotum is situated at about middle (in *abbreviatum* this dilatation is less angular and



situated behind middle). Middle of anterior margin of pronotum strongly produced almost to level of anterior angles (in *abbreviatum* very little produced forwards). Carinae on pronotal disc converging apically (there subparallel in *abirevium*). Genal canthus, viewed from the side, with fine and sharp carina along midline; in dorsal aspect, slightly diverging backwards and, at level with the posterior margin of eyes, abruptly and angularly bent inwards and almost transversely narrowed towards tempora (in *abbreviatum* the genal canthus, viewed from the side, is evenly convex and not carinate; in dorsal aspect, it is dilated in front of eyes, then, at level with the anterior margin of eyes angularly bent inwards and obliquely narrowed towards tempora, meeting the latter at about level with the middle of eyes. Moreover the elytra show less prominent humeral angles and the second costa is more strongly bent inwards basally).

Locality: Southern Angola: surroundings of Moçamedes, praia das Conchas, 16 to 18 October 1949, leg. A. de Barros Machado (1 spec., holotype, sex not determined, in M.D.); Moçamedes, desert, 23 October 1949, leg. A. de Barros Machado (1 paratype in T.M.).

I have named the new species in honour of Dr. A. de Barros Machado, director of the Museu do Dundo.

Systematic position: A carinate genal canthus and separated elytral costae are likewise shown in the Angolan *Ps. pygmaeum* (Haag), but this species belongs to a quite different group, which is characterized by the broadly denticulate epipleural carina of elytra (smooth in *abbreviatum* and *Machadoi*) and the narrow subparallel pronotum, the sides of which are strongly emarginate in front of the sharply rectangular posterior angles.

***Psaryphulum pygmaeum herero* subsp. n.**

Differing from the holotype of *P. pygmaeum* (Haag) (ex Z.St.S.) in the larger and broader body (5 1/4 mm. long, 2 1/4 mm. broad; in *pygmaeum* f. t. 4 1/2 mm. long and 1 1/2 broad), and the course of the dorsal costae on elytra. In the typical *pygmaeum* the first costa of each elytron is more abbreviate apically than the second one; in the new form the first costa is longer than the second one and extending backwards comparatively far beyond the end of the second costa.

Locality: South West Africa, Northern Damaraland: Warmbad, February 1925, leg. Museum Expedition (1 spec., holotype, sex not determined, in South African Museum).

***Psaryphulum damara* n. sp.**

(Plate X, fig. 176)

Black, with the sides of upper surface, underside, tarsi and apical joint of antennae reddish brown; dull; setulose; complanate. Head above twice

as broad as long, densely rugose, minutely and sparsely setiferous, with a fine and complete median carina and deep, small, elongate pre-ocular grooves. Epistome emarginate at middle of apical margin, with broadly rounded lateral portions, dilated towards genae and including with the latter a wide angle. Genae large, broadly rounded and projecting outwards, with the apical part of canthus obliquely, almost transversely narrowed towards neck. Genal canthus, viewed from the side, finely carinate and completely dividing eyes. Supra-antennal portions moderately raised. Dorsal portion of eyes narrow and long. Supra-orbital ridges strongly elevate, only a little produced forwards beyond eyes, slightly bent inwards anteriorly. Vertex with transverse declivity in front of occiput. Submentum transverse, broadly emarginate apically, with densely and somewhat reticulate, rugose sculpture. Buccal fissure lobes dentiform, pointed apically, extending to about level of the apical emargination of submentum, densely covered with oblique striae. Antennal sulcus deep, with sharply defined lateral margins. Ventral portion of eyes very small, linear, situated at the end of the antennal-ocular groove. Antennae hardly longer than the head is broad, compressed and slightly accrescent; basal joint the longest, one and a half times as long as broad, almost as long as the two following joints combined and a little longer than apical joint; second joint and third one about square, almost of same size, but the second joint a little broader than the third one; the following intermediate joints transverse, becoming gradually broader towards apex, with the fourth joint distinctly shorter than the preceding joints and about one and a half times as broad as long, and with the ninth joint almost twice as broad as long; apical joint large, strongly broadened towards apex, a little shorter than the two previous joints combined, and only a little longer than broad. Pronotum strongly cordiform, broadest behind middle, there one and a half times as broad as head, and one and a half times as broad as long, with two sharply carinate and complete discal costae, and with broadly dilated and flattened, foliaceous lateral portions. Anterior margin comparatively strongly emarginate, with the obtuse anterior angles strongly produced forwards to level with posterior margin of eyes. Sides with sharp, and minutely and densely crenulate lateral edge, from the broadest point of pronotum slightly rounded and strongly narrowed towards anterior angles, subangularly narrowed towards base, and deeply sinuate in front of the sharp, minutely prominent, rectangular posterior angles. Base about as broad as anterior margin, with slightly produced median lobe, and at each side of it with slightly emarginate lateral portions. Discal costae gradually diverging backwards, with slightly concave intervening space, and with rather strong oblique declivity of the outer margin; the foliaceous lateral portions, at each side, about twice as broad as the inter-costal discal space basally. Integument densely, coarsely

and shallowly punctured, with the intervals between punctures raised to a fine and rugose reticulation. Prosternum with similar sculpture, along the fine carina of anterior margin with narrow sulcus; antennal sulcus on episternum deep and completely closed-in continuous with that on underside of head; intercoxal apophysis a little projecting beyond coxal cavities, attenuate apically. Elytra oblong-oval, almost twice as long as broad, broadest at middle, there about one-quarter broader than pronotum, with four sharply carinate costae. There are on each elytron two costae, running parallel with the slightly rounded outlines of elytra, therefore slightly curved outwards; the inner costa is situated nearer to suture than to outer costa, complete, becoming narrowed and subparallel on apical declivity, ending just in front of the apical margin of elytra; the outer costa runs very near to the lateral edge of elytra, is abbreviate apically and ends at about level with the top of the apical declivity of inner costa. Epipleural carina complete, sharp, minutely and densely crenulate, entirely visible from above and forming the lateral outlines of elytra; abruptly bent upwards and dilated at level with the base of anal sternite. Base much broader than pronotal base, closely jointed to the latter and slightly overlapped by the median lobe of it; arcuate, with the lateral portions obliquely sloping towards the obtuse, but almost rectangular humeral angles. Sides slightly rounded and faintly narrowed towards base, strongly narrowed in front of the scarcely caudate apex. Apical declivity high and steep, almost perpendicular; extreme apex with minute hiatus at suture. Integument densely covered with irregular and setiferous fine primary granules, intermixed with very fine and minute secondary ones, with the background between granules appearing as if uneven. Dorsal convexity, viewed from behind, with straight or slightly concave contours at the strongly raised discal interval between inner costae and across suture, with the contours of the median interval of each elytron strongly oblique, and the contours of the narrow lateral interval between outer costa and lateral edge (=epipleural carina) perpendicular; in the same view, the median interval is distinctly broader than the sutural one, and about twice as broad as the lateral one. Reflected portion densely punctured, minutely corrugate along lateral edge. Mesosternum rugose, with the intercoxal apophysis raised to coxal level, distinctly narrower than prosternal apophysis. Metasternum and abdomen discally with fine and not dense, round punctures, bearing each a fine and adherent yellowish bristle; reticulate at sides; metasternum a little longer than the second abdominal sternite, with the discal portion flattened and delimited by obsolete edges laterally, with prolonged and narrow intercoxal process anteriorly; basal sternite of abdomen likewise with flattened discal portion, which is delimited laterally by rather sharp and raised edges, with the intercoxal process prolonged and about as broad as prosternal apophysis.

Legs short. Tibiae strongly dilated towards apical margin, with flat outer surface. Ungual joint of intermediate tarsi about twice as long as basal joint, that of posterior tarsi only a little longer than basal joint.

Dimensions : Length  $5 \frac{3}{4}$  mm., width  $2 \frac{3}{4}$  mm., height  $1 \frac{1}{2}$  mm.

Locality : South West Africa, northern Damaraland : Cayimaais, March 1925, leg. Museum Expedition (1 spec., holotype, sex not determined, in S.A.M.).

This remarkable new species is strongly differentiated from all the other *Psaryphulum* by the presence of only two costae (instead of three) on each elytron and the broad cordiform pronotum.

#### **Aspilomorpha n. gen.**

Body complanate, black, dull, setulose, of *Adelostoma*-like appearance. Head transverse, enclosed in the prothorax, on upper surface rugose, covered with yellowish semi-erect bristles. Epistome with shallow emargination; lateral portions with strongly sinuate outlines. Genae strongly dilated towards epistome, completely dividing eyes. Dorsal part of eyes oblong, with almost perpendicular surface, with a transverse impression in front of it. Supra-orbital ridges well pronounced, obliquely produced towards middle of vertex. Supra-antennal portions slightly raised. Mandibles bifid apically, concealed by epistome. Submentum transverse, about two and a half times as broad as long, shallowly emarginate apically, with the straight sides strongly dilated towards base; the latter slightly emarginate. Buccal fissure lobes large, with triangular apical margin, produced forwards to level with apical margin of submentum. Infra-orbital sulcus distinct. Ventral part of eyes small, of sub-lunulate shape. Antennae ten-jointed, incrassate, accrescent, slightly compressed, with some black bristles, a little longer than the head is broad, with transverse intermediate joints, and with all the joints pedunculate, except for the third one, which is closely fitted into the second; apical joint large, a little shorter than the two previous joints combined, with the apical margin of the sclerotized part produced into a minutely dentiform angle at middle of compressed surfaces. Pronotum much broader than head, transverse, rugosely punctured, with strongly raised and bicarinate discal convexity, which is strongly projecting beyond base and less so beyond anterior margin of pronotum. Lateral surfaces dilated and flattened, covered with several erect long hairs; lateral edge thick, granular and furnished with very short bristles. Prosternal apophysis about as broad as buccal fissure lobes, slightly sulcate along midline and a little projecting horizontally beyond coxal cavities, with perpendicular apical declivity; episternum of prosternum with deep, broad and complete antennal sulcus, which is almost in contact with posterior angles of prothorax below. Elytra almost a little narrower than pronotum,



with moderately rounded sides, emarginate base, produced and raised humeral angles, and with an abrupt, high and steep apical declivity. Densely granulate in transverse rows, covered with some erect bristles; with two subcarinate dorsal ridges and a lateral one. Epipleural ridge complete, but very fine, in front of the apex bent dorsad and thence visible from above and delimiting the outlines of elytra. Mesosternal apophysis perpendicular, one and a half times as broad as prosternal apophysis, truncate apically. Metasternum flat, strongly transverse, a little shorter than second sternite of abdomen. Median process of basal sternite more than three times as broad as prosternal apophysis, and much broader than submentum; the four first sternites becoming shorter and much narrower towards apex, with the fourth sternite the shortest and only half as long as the previous one; anal sternite rounded apically, a little longer than third sternite. Sutures of pleurites absent. Legs stout, granulate and with short adherent yellowish bristles. Femora slightly compressed, with the lateral outlines of underside sinuate in front of lobiform apices; underside flat. Tibiae a little shorter than femora, slightly compressed, dilated towards apex, with the outer surface flattened and furnished with a few short spines laterally, more or less concealed by short bristles; lateral margin of anterior tibiae sinuate in front of the sharp and prominent apical angle, with the apical margin of tibiae as broad as the three proximal joints of anterior tarsi are long together; posterior tibiae distinctly curved inwards, the intermediate ones almost straight; calcares short, about twice as long as the spinulae of coronula. Tarsi short, half as long as tibiae, spinose beneath; the joints of anterior tarsi strongly transverse, except for the ungual joint, which is longer than the two previous joints combined; the joints of intermediate tarsi longer, those of posterior tarsi elongate, with the ungual joint only a little longer than basal joint. Claws about twice as long as tibial calcares.

Type species: *Aspilomorpha mediolobata* n. sp.

***Aspilomorpha mediolobata* n. sp.**

(Plate II, fig. 104; Plate XI, fig. 178)

Greyish black, with the apices of antennae and the tarsi reddish brown, and the maxillary palpi red. Head enclosed in the prothorax up to middle of eyes; above densely covered with a rugose sculpture all over its surface. Epistome with the apices of the apical margin of lateral portions smooth and shiny; contours of lateral portions angularly sinuate laterally; a minute and very short median carinula can be observed on surface of the apical margin of epistome, minutely projecting beyond the outlines of the latter. Pre-ocular grooves shallow. Supra-orbital ridges almost in contact with one another on middle of vertex. Pilosity very short, sparse and adherent. An-

tennae sparsely covered with yellowish bristles proximally, with black ones distally; basal joint about as long as third one; second joint a little longer than broad; third joint one and a half times as long as broad and only a little shorter than the two following joints combined; the following intermediate joints transverse, becoming gradually broader towards apex; the two pre-apical joints twice as broad as long; apical joint of about the length of the two preceding joints taken together, or as long as the third joint. Pronotum broadest between posterior angles, there twice as broad as head and two-thirds broader than long. Middle of disc raised and situated at a higher level than the horizontally flattened lateral portions, projecting strongly beyond base as well as anterior margin, with two sharp median carinae; the space between carinae distinctly concave. Anterior margin broadly emarginate, with the base of emargination slightly overlapped by the median lobe of discal convexity; the lateral portions of emargination with some longer yellowish hairs. Anterior angles obtuse. Sides strongly and almost straightly dilated towards posterior angles, with the lateral edge thickened, obsoletely crenulate and ciliate with short and dark bristles. Posterior angles obtusely rounded. Base with strongly developed median lobe, formed by the prolongation of the median convexity of disc, which is strongly produced backwards beyond the level of posterior angles; lateral parts obliquely sloping towards median lobe and distinctly sinuate in front of the latter, furnished with a fringe of very short hairs of a whitish gray colour; posterior margin of median lobe emarginate between discal carinae. Integument uniformly covered with the same dense and rugose sculpture as on head, with a few very short and adherent bristles and with some more numerous, stout and long, dark erect hairs on lateral portions. Under-side with sparse short bristles, concentrated on the outer portion of episternum of prosternum; background of the deep antennal sulcus smooth. Elytra broadest at middle, there hardly as broad as pronotum, flattened discally but with steep, abrupt and obliquely sloping apical declivity. Sides faintly rounded, strongly narrowed towards base, almost subparallel at middle, and strongly caudate apically. Base broadly emarginate, with the slightly raised humeral angles acute and produced forwards. The flat discal surface shows two longitudinal, denticulate and elevate dorsal ridges on each elytron; the inner ridges are slightly curved outwards, approximate and subparallel on apical declivity, with their ends almost in contact with the lateral ridges; the outer ridges are abbreviate and are ending on top of apical declivity; the lateral ridge, which is more denticulate than the discal ridges, is situated at a lower level than discal surface, with the interval between it and the outer discal ridge obliquely sloping downwards, forming basally the raised humeral margin, running parallel with the outlines of elytra and

being abruptly bent inwards at about middle of apical declivity, whence it runs a short distance in a longitudinal direction, becoming convergent to suture in front of apex. The lateral outlines of elytra, however, are not defined by this lateral (or humeral) ridge, but by the denticulate contours of the epipleural ridge; the latter is very fine, almost coalescent with the apical margin of elytra apically, abruptly bent dorsad at level of the penultimate sternite of abdomen, thence running parallel with the lateral ridge towards humeral angle, where it becomes evanescent; the interval between epipleural carina and lateral one is perpendicular, broadened and somewhat concave at apical declivity. Integument composed of dense granular rugosities, which are tending to become transversely confluent, scattered and more distinctly granular along suture and on apical declivity; the numerous bristles are rather long, dark and erect. Reflected portions with coarse and very dense punctures, and with granulate intervals between punctures. Underside of afterbody densely rugose and sparsely covered with short yellowish bristles. Legs as indicated in the description of genus.

Dimensions: Length 6 1/2 mm., width 3 mm., height 2 1/4 mm.

Locality: Belgian Congo: Katanga, Nyonga, May 1925, leg. G.F. de Witte (1 spec., holotype, sex not determined, in B.C.M.).

Systematic position: See key to genera.

To the new genus belongs also *Adelostoma meridionalis* Ancy, 1881, which the author himself a short time after its description (1881a) supposed to represent an independent genus allied to *Psaryphis*; Fairmaire, 1887, took this species to be a *Geophanus* (cf. also Gebien, 1937).

I refer to *A. meridionalis* (Ancy) a specimen from the Tanganyika Territory (Thua River, November 1933, leg. MacArthur, in Coryndon Museum); it agrees completely with the description of the holotype from Uzagara. It is distinguished from *A. mediolobata* in the shorter and broader shape of body; the presence of a complete median carinula on upper surface of head, reaching the point of coalescence of the supra-orbital ridges on middle of vertex; the stouter antennae, the third joint of which is only a little longer than the second joint and much shorter than the two following joints combined; the more strongly curved posterior tibiae; the hardly prominent outer apical angle of anterior tibiae; the strongly rounded sides of pronotum, which are distinctly narrowed towards posterior angles, including the widest space in front of the latter; the broadly rounded posterior angles of pronotum (which are obtusely rectangular in *mediolobata*); and the lateral contours of elytra, which are gradually rounded and narrowed towards the caudate apical lobe (in *mediolobata* they are abruptly and angularly bent inwards in front of the caudate apex).

Both species agree well in the arrangement of the elytral sculpture

**Aspilomorpha Alfieri n. sp.**

(Plate XI, fig. 179)

In the general appearance the new species most nearly resembles the two preceding species, but differs from both in the abbreviate third antennal joint, being distinctly shorter than the enlarged second joint; and in the arrangement of the elytral carinae. The inner discal carinae are straight and only slightly and gradually convergent to the point of coalescence with the lateral ridge (in the two compared species the inner costae are curved from base to the top of apical declivity, whence they become approximate and run parallel with one another and suture to the point of coalescence with the lateral carina).

For the rest the new species agrees well with *A. meridionalis* in the complete median carina on surface of head, the rounded sides of pronotum, the broadly rounded posterior angles of the latter, the course of the lateral contours of elytral apex, as well as in the not prominent outer apical angle of anterior tibiae.

Dimensions: Length 6 mm., width  $2\frac{1}{4}$  mm.

Locality: Tanganyika Territory: Tabora, November 1942, leg. Meneghetti (1 spec., holotype, sex not determined, ex Coryndon Museum, in B.M.).

I have much pleasure in naming the new species in honour of Mr. Anastase Alfieri, General Secretary of the Société Fouad Ier d'Entomologie, Cairo.

**Stipsostoma n. gen.**

(Figs. 35, 82, 85; Plate II, Fig. 103; Figs. 108-110; Plate XI, Figs. 180, 181)

Body apterous, complanate, dull, bare, black, recalling an oblong *Stips* in shape. Head enclosed in the prothorax up to genal angles, transverse, much narrower than prothorax; above with two deep and oblique pre-ocular impressions, with an elevate median carina, and with oblique supra-orbital crests, running each from posterior margin of eyes towards median carina; densely covered with coarse and setiferous granules, tending to become confluent on genal portions, becoming scattered in pre-ocular impressions. Epistomal surface sloping downwards, with the apical margin broadly emarginate at middle. Genae straight and strongly dilated forwards, about two and a half times as long as third antennal joint, meeting the lateral outlines of epistome in an obtuse angle; genal canthus complete, dividing the eyes into a dorsal and ventral part. Dorsal part of eyes small, roundish, compounded of a comparatively small number of corneal facets, with the inner margin overlapped by a small and raised dilatation of the base of supra-orbital ridges. Labrum concealed under epistome, furnished with a fringe of short and



golden bristles apically. Mandibles situated under epistome, bifid apically. Submentum large, strongly transverse, rounded at sides; apical margin with broad and straight emargination at middle, and lobiform anterior angles. Mentum linearly transverse, shallowly emarginate apically. Apical joint of maxillary palpi slender and fusiform. Buccal fissure lobes large, covering the base of mandibles, with the sub-truncate apical margin produced forwards almost up to level with the tip of lateral lobes of submentum. Gular surface flat, delimited by subparallel, slightly arcuate sulci at sides, with the lateral portions convex and sloping towards the infra-orbital carina, from which they are separated by a deep longitudinal sulcus. Infra-orbital carina crenulate, with a distinct dilatation basally, covering the inner portion of eyes. Ventral part of eyes transversely reniform. Integument of underside of head densely covered with elevate granules, except for the smoothed background of sulci. Pronotum large, broadest at base or a little in front of it, more than twice as broad as head and more than twice as broad as long, hardly narrower than elytra, with convex discal portion and depressed and concave lateral portions. Disc at middle with two elevate longitudinal carinae, becoming divergent towards base; between carinae sometimes with a fine and obsolete median carinula; on each side and laterad of carinae there is a variously shaped elevation at middle of the lateral half of discal convexity, formed by a hump or transverse ridge, which often runs obliquely backwards towards posterior angles of pronotum. Lateral portions of pronotum separated from discal convexity by a linear longitudinal impression, which is often dilated into a spacious groove apically. Anterior margin much narrower than base, deeply emarginate at middle, with strongly produced lateral lobes; immarginate. Sides rounded and narrowed from middle towards anterior margin, only a little rounded behind middle and almost subparallel a rather long distance in front of posterior angles; lateral edge distinctly bent upwards and provided with a duplicate margination, comprising two sharp, obsoletely crenulate carinae, which include a narrow intervening space, visible from above. Base slightly emarginate and sinuate at both sides, with the middle broadly produced backwards into a rounded lobe, which is straightly cut off or emarginate between discal carinae; acies immarginate and serrate-denticulate. Anterior angles obtusely acuminate, posterior ones rectangular. Integument densely granulate on disc, with the granules becoming finer and concentrated on basal half of discal carinae and lateral median elevations; the foliaceous lateral portions with very rough, irregular, partly confluent punctures, with the intervals between punctures raised to narrow and sharp, confluent rugosities. Prosternum convex, transverse, separated from episternum by complete sutures; apophysis spoon-like and horizontally produced beyond pro-coxal cavities, with the apex perpen-

dicularly declivous towards base of prothoracic foramen; antennal sulcus on episternum broad and shallow, with a steep and sharp, almost perpendicular declivity along inner margin, abruptly ending a short distance from prothoracic base and there bordered by a fine transverse plica, open towards lateral portions of episternum; inner portion of episternum strongly sloping towards the sharp edge of antennal sulcus, the outer portion flat, almost horizontal or slightly raised. Integument of underside densely granulate, except for the smooth background of antennal sulcus. Basal surface of prothorax, in sectional view, with the inferior carina meeting the foraminal margination above middle of foramen; the latter strongly transverse and large. Elytra complanate, flat, oblong, only very little broader than pronotum, with subparallel sides, rounded and narrowed apically, and with a steep and abrupt apical declivity. Base broadly emarginate and obsoletely carinate only on scutellar portion. Scutellum transversely elongate. Suture distinctly raised, at each side flanked by a longitudinal row of fine granules. Disc of each elytron slightly concave, and delimited laterally by an elevate, arcuate, at the top minutely crenulate costa, which is situated on lateral half, rounded and narrowed towards base and apex; the apical course of this costa is parallel with the suture, becoming convergent with the latter only on extreme apical surface; a short, obliquely transverse carinula units the discal costa with the raised suture on top of apical declivity. Sides with duplicate margination, composed of a humeral costa and a sharp lateral one; the basal half of the latter, or more, is visible from above; the humeral costa coalesces apically with the discal costa at the point, where the subparallel pre-apical part of the discal costa is angularly bent inwards; the space between humeral and discal costae is concave. The lateral carina, which is in fact the epipleural delimitation of elytra (epipleural carina) is complete and abruptly curved dorsad at about level of the penultimate sternite of abdomen; the intervening space between the humeral costa and the lateral (or epipleural) one is deeply concave and latero-dorsal in position. Because of the anastomosing of the apices of the discal and humeral costae together with the transverse supplementary carina between discal costa and suture, a very characteristic pentagonal space becomes defined on apical declivity of elytra. Integument covered with fine setiferous granules, more or less arranged in short transverse rows, with deepened intervals between the latter. Mesosternum with fine carinula at basal portion; intercoxal apophysis raised to level of mesocoxal cavities, excavate, with the parallel lateral margins bent upwards, and subtruncate apically. Discal portion of metasternum flattened and bordered by subcarinate edges laterally, about as broad as long, with variously shaped sides, more or less emarginate at middle of apical margin. Discal portion of the three first sternites of abdomen flattened

and at level with the disc of metasternum, laterally bordered by more or less carinate edges, being divergent on basal sternite, subparallel on the following sternites; the apical margin of the three intermediate sternites with submarginal declivity. Lateral portions of metasternum and of the three basal sternites strongly sloping towards elytral border. Integument of the afterbody below covered with rather dense setiferous granules, except for the pre-apical sternite; anal sternite with conglomerated bristles at apex. Legs elongate and slender, covered with a dense and setiferous granulation, except for the smooth underside of femora. Tibiae with the inner and outer surface flattened and subsulcate; intermediate tibiae distinctly S-curved; the posterior ones almost straight, faintly dilated towards apex, there about twice as broad as basally, or less, or as broad as the basal joint of posterior tarsi is long; anterior tibiae shorter, a little more dilated towards apex, with the outer margin slightly sinuate in front of the dentiform apical angle, with the apical margin approximately as broad as the three proximal joints of anterior tarsi combined. Tibial calcares well developed; those of anterior legs about as long as the basal joint of anterior tarsi, those of intermediate and posterior legs shorter than the basal joint of the respective tarsi. Tarsi strongly compressed, with short spinulae beneath and with spinose coronula; anterior tarsi short, with all joints transverse, except for the ungual one, which is a little shorter than the three preceding joints combined; intermediate and posterior tarsi with triangular intermediate joints, being about as broad as long, with the basal and ungual joints longer than broad, and with the ungual joint longer than the basal one. Claws rather long, of similar length as tibial calcares.

Type species: *Steira sculpta* Gebien, 1920.

Owing to the elongate basal joint of antennae and carinately delimited discal portions of metasternum and basal sternites, Gebien placed his *sculpta* to *Stips* (olim *Steira*). In spite of the striking resemblance of this species to *Stips Dohrni*, I have no doubt whatsoever that it belongs to a different phylogenetic line, in representing an independent genus on the basis of the complete epipleural carina (altogether absent in *Stips*, except for *Stips costata*, in which it is apically developed), the duplicate margination of the sides of pronotum, the peculiar formation of apical declivity of elytra, and the structure of pronotal base.

***Stipsostoma holgatensis* n. sp.**

(Plate XI, fig. 181)

The new species is allied to *St. sculpta* (Geb.) (cf. plate XI, fig. 180), to which it stands to some extent in a similar relation, as *Stips costata* (Westw.) (cf. plate XI, fig. 182) stands to *Stips Dohrni* (Haag) (cf. plate

XI, fig. 183); and this not only with regard to the similar arrangement of the costal sculpture on elytra, but also as to the geographical distribution. Both sculpturally convergent species, viz. *Stips Dohrni* and *Stipsostoma sculpta* are strictly confined to territories North of the Orange River, whilst the other couple of the convergent species, *Stips costata* and *Stipsostoma holgatensis* n. occur exclusively in territories South of the Orange River.

*St. holgatensis* differs specifically from *St. sculpta* as follows :

Body broader, less elongate, more deplanate. Pronotum shorter; the disc less convex, with the interval between median carinae flat and without supplementary central carinula; the obtusangular ridge on each side laterad from distal carinae is only slightly indicated by a little obvious hump and is not produced backwards towards posterior angles of pronotum, as it is the case in *sculpta*. Integument covered with finer granules, more concentrated on the lateral portion of discal convexity. Elytra broader and shorter, with the sides slightly rounded (subparallel in *sculpta*). The position of the discal costa is similar to that in *Stips costata*, in being more approximate to the sides of elytra than in *sculpta* (the latter, with regard to the position of the discal costa agreeing with *Stips Dohrni*); the discal costae run subparallel with one another a rather long distance at middle; they are strongly rounded and almost abruptly narrowed towards base, rounded and gradually narrowed towards apex; the discal space between them and across suture is broadest at basal quarter of elytra; the distance between the dorsal costa and suture, measured at middle of each elytron, is about four to five times as broad as the respective space between the discal costa and the humeral one (in *sculpta* the discal costae are subparallel only a very short distance at middle, rounded and gradually narrowed in a similar way towards base, as well as towards apex; the discal space between the discal costa and suture, measured at middle of each elytron, is only a little more than twice as broad as the respective space between the discal costa and the humeral one). The humeral costae are slightly rounded (subparallel in *sculpta*), basally convergent (subparallel in *sculpta*), and, viewed from above, concealing the epipleural (or lateral) carina from middle to apex (in *sculpta* the lateral carina, viewed from above, is entirely visible). In exact caudal view, the two lateral intervals on each elytron (between the discal and humeral and epipleural costae) are perpendicularly declivous, lateral in position (in *sculpta* concave, but still dorsal in position). The pentagonal space on the apical declivity has a perpendicular position (obliquely sloping in *sculpta*). The transverse rows of granules are more numerous and composed of finer granules.

Sides of the discal portion of metasternum strongly rounded and strongly narrowed towards anterior and posterior margins (in *sculpta* subparallel at middle, and, in forming an obtuse angle, narrowed



towards apical margin). Discal portion of the three first sternites of abdomen narrower. The transverse submarginal row on top of the apical declivity of the three intermediate sternites composed of well separated and erect granules (in *sculpta* these granules are confluent and abraded, forming an obtuse crest).

Dimensions: Length 9 to 11 1/2 mm.; width 5 to 6 1/4 mm.

Localities: Northern Little Namaqualand: Holgat, 23 November 1948, leg. University California-Transvaal Museum Expedition (52 spec., holo- and allotype in T.M., C.A.Sc. and BCM.); same locality, September 1949, leg. C. Koch (109 paratypes in T.M.); same locality, 2 September 1950, leg. C. Koch and G. van Son (44 paratypes in T.M.); Richtersveld: Kuboos, September 1949, leg. C. Koch (1 paratype in T.M.); Heels Kloof, 8 September 1950, leg. C. Koch (1 paratype in T.M.).

Habitat: On sandy soil under stones, often gregariously; also in mammal-holes.

***Phytolostoma limpopoana* n. sp.**

(Figs. 36, 83; Plate II, figs. 103, 105; Plate XI, fig. 184)

(For the differential diagnosis of the new genus *Phytolostoma* see key to genera on pages 3-39).

Body oval, complanate, shortly setiferous, dull, black, often covered with earthy particles. Head enclosed in the prothorax up to genal angles, above with rather sparse, fine, setiferous granules. Epistome with deep, almost triangular emargination at middle. Genae strongly dilated towards lateral angles of epistome, and strongly projecting beyond eyes. Lateral contours of epistome strongly and straightly narrowed towards subtruncate apical margin. Eyes completely divided by genal canthus; the dorsal part comparatively large, oblique, with the inner margin overlapped by a sharp, slightly acclivous supra-orbital edge, which is prolonged towards median carina. In front of eyes there is a rather deep and broad transverse impression, divided into two foveae by the fine median carina; the anterior margin of this impression slightly raised and sometimes transversely subcarinate. Median carina extremely fine, originating at the point on middle of head, where the supra-orbital ridges are coalescent, becoming evanescent towards front, but almost reaching the apical margin of epistome; vertex between eyes with a rudimentary prolongation of this median carina. Labrum flat, truncate apically and there cirrous. Mandibles concealed by epistome, bifid apically. Maxillary palpi small, with the apical joint subcylindrical and about twice as long as penultimate joint. Submentum transverse, with truncate base, the sides straightly dilated towards anterior margin; the latter with a broad and straight emargination at middle and produced lateral angles: covered with fine setiferous granules. Buccal fissure lobes

broad, flat, with the apical margin obliquely rounded and reaching the level of apical emargination of submentum. Underside of head covered with dense and fine setiferous granules, except for the smoothed background of the rather broad infra-orbital sulcus, which runs along the sides of head. Antennae a little shorter than the head is broad, stout, shortly setiferous; basal joint approximately as long as the two following joints taken together or a little shorter, two-thirds longer than broad; second and third joints of similar size, about square; fourth joint slightly transverse, very little shorter than the third one; the following intermediate joints becoming gradually shorter and broader towards apex; ninth joint a little more than twice as broad as long; apical joint large, longer than the penultimate one, but as broad as that, with the apical margin of the sclerotized part angulate. Pronotum transverse, broadest at base, there twice as broad as head, not quite as broad as long, with duplicate lateral margination, with two discal carinae, and with the space between these carinae produced beyond level of anterior margin and base. Anterior margin deeply emarginate, with the lateral angles strongly produced forwards and almost rectangular, and with the middle lobiform and distinctly produced beyond level of emargination. Sides rounded and gradually dilated towards base, subparallel in front of posterior angles, with duplicate and carinate margination; both the lateral carinae visible from above. Base much broader than anterior margin, with a fringe of short yellowish bristles; sides sinuate and the middle strongly and comparatively far produced backwards beyond level of posterior angles; the latter sharply rectangular or slightly acutangular. Disc strongly raised, the lateral portions flattened and concave; on middle with two sharp and complete carinae, running in a divergent direction from anterior margin to a point situated before middle, there angulose and thence very slightly narrowed towards base, or subparallel; the space between carinae slightly excavate, with an obtuse transverse ridge behind middle. The sloping lateral parts of discal convexity with an obsolete transverse elevation on each side of the pre-median angle of discal carinae, with the surface in front and behind this ridge slightly impressed. Foliaceous lateral portions of pronotum slightly concave, with moderately raised lateral margins. Integument densely covered with fine setiferous granules, becoming scattered only in the impressions on space between discal carinae. Underside of prothorax densely covered with setiferous granules; the middle of prosternum in the ♂ raised, more convex than in the ♀, and provided with a patch of conglomerated coarse granules and a yellowish, somewhat lanuginose, rather dense pilosity. Prosternal apophysis horizontally projecting beyond coxal cavities, rounded and dilated towards apex and shortly pointed apically. Antennal sulcus on episternum of prosternum very deep and completely closed-in. Basal surface

of prothorax, examined in sectional view, very similar to that in *Stipso-stoma*. Elytra oval, broadest behind middle, there only a little broader than pronotum, with the base exactly as broad as pronotal base; on each elytron with a median discal carina, a humeral one and the lateral carina, formed by the epipleural margination. Sides almost subparallel in the ♂, slightly rounded in the ♀, rounded and narrowed apically, with the apical declivity rather steep and obliquely sloping towards apex. Discal carina more approximate to suture than to lateral outlines of elytra, with sharp but slightly wavy crest, running parallel with suture from base to about middle, there becoming convergent to suture and coalescent with humeral carina on about middle of apical declivity, continuing as a single carina, and convergent to suture towards apex, and ending abruptly a short distance in front of apical margin. The humeral carina, sharp and slightly wavy on the top, runs parallel with the discal carina; the interval between it and the latter is as broad as the interval between the discal carina and suture, and shows on top of apical declivity a short, rudimentary, longitudinal carinula at about middle of interval, often reduced to a kind of elongate tubercle. Epipleural carina entirely visible from above. Suture raised, on each elytron flanked by a longitudinal row of very fine granules. Both the dorsal intervals concave, the outer declivity of the humeral carina perpendicular and concave; the interval between the epipleural carina and the humeral one, in caudal aspect, only a little broader than half the width of the interval between the humeral carina and the discal one. Integument densely covered with fine setiferous granules, arranged in transverse rows; the intervals between transverse rows broader than the diameter of granules and slightly deepened. Reflected portions covered with coarse and irregular granules. Underside of afterbody evenly setiferous and granulate. Mesosternal apophysis short, hardly broader than the prosternal one, impressed along midline, subtruncate apically. Metasternum of about the length of the second sternite of abdomen, much shorter than basal sternite, slightly flattened discally and with very shallow emargination apically. Intercoxal process of basal sternite about twice as broad as prosternal apophysis. Legs short. Femora compressed and slightly clavate, with the underside faintly concave and smooth. Tibiae almost straight, dilated towards apex, minutely crenulate at sides of the flattened outer surface, with acute and sinuate apical angles; apical margin of anterior tibiae nearly as broad as the four proximal joints of anterior tarsi combined; calcares well developed, moderately long, those of intermediate tibiae about as long as the basal joint of intermediate tarsi, those of posterior tibiae half as long as the basal joint of posterior tarsi, and a little longer than claws. Tarsi short, slightly compressed, spinose; joints of anterior and intermediate tarsi transverse, except for the ungual joint, which is about twice as long as the basal

joint; joints of posterior tarsi elongate, with the ungual joint about as long as the basal one. Claws small and short, about the length of the ungual joint.

Dimensions: Length 6 to 7 1/2 mm., width 3 1/4 to 4 1/4 mm.

Localities: Northern Transvaal, Zoutpansberg district: Salt Pan, 27 July 1949, leg. University California-Transvaal Museum Expedition (29 spec., holo- and allotype, paratypes in T.M.); Futie, 1 August 1949, leg. University California-Transvaal Museum Expedition (53 spec., paratypes in T.M., C.A.Sc. and B.C.M.); Vivo, 7 April 1950, leg. G. van Son (87 paratypes in T.M.).

***Phytostoma limpopoana Wheliani* subsp. n.**

(Plate XI, fig. 185)

The new form is easily distinguished from the typical *Ph. limpopoana* as follows.

Body elongate and more subparallel. Pronotum slenderer and longer, only three-quarters broader than long. Elytra with subparallel sides, with the dorsal costae more elevate and strongly wavy, and with the epipleural carina distinctly crenulate; the discal costae subparallel from base to the top of apical declivity, where they become abruptly bent inwards; intervals between costae and suture strongly concave; apical declivity high and almost perpendicular.

In the typical *limpopoana* the body is shorter and broader. Pronotum more than twice broad as long. Elytra with distinctly rounded sides, with the dorsal costae less elevate and only slightly wavy, and with the epipleural carina smooth; the discal costae distinctly curved (as they are parallel with the rounded outlines of elytra) from base to the top of apical declivity, and becoming gradually convergent towards the junction with the humeral costa; intervals between costae and suture faintly concave; apical declivity obliquely sloping and less high.

Localities: South-East Bechuanaland: Macloutsie B., December 1912, leg. C. Fry (2 spec., holo- and allotype in T.M.). Southern Rhodesia: Bulawayo, 10 August 1919, leg. Rhodesian Museum (4 paratypes in T.M. and Entomological Branch of the Department of Agriculture, Salisbury).

I name the new form in honour of Mr. A.J. Whellan, Chief Entomologist of the Entomological Branch of the Department of Agriculture at Salisbury.

***Stips costata grandis* subsp. n.**

(Plate XI, fig. 182)

The new subspecies differs constantly from the typical *costata* (Westw., 1837) as follows:



Body of larger size, 9 to 12 mm. long, 7 to 8 3/4 mm. broad (in *costata* f. t. 7 1/4 to 9 mm. long, 5 to 6 1/2 mm. broad). The elytra are round (roundish-oval in *costata* f. t.); the abbreviate humeral carinula is very short (cf. plate III, fig. 114), much shorter than the space between the two discal carinae on pronotum is broad at base (in *costata* f. t. the humeral carinula is much longer (cf. plate III, fig. 113), approximately as long as the space between discal carinae on pronotum is broad at base); the dorsal costae are less elevate, less strongly narrowed towards base and abruptly ending apically (in *costata* f. t. the dorsal costae are more elevate, strongly narrowed towards base, and gradually becoming evanescent apically); the interval between costa and suture on each elytron, when viewed from behind (cf. plate III, fig. 116), is about three times as broad as the outer declivity of costa is high (only twice as broad as the latter (cf. plate III, fig. 115) in *costata* f. t.); the discal portions of metasternum and basal sternite of abdomen are narrower.

Localities: Little Namaqualand: 12 miles before Klaver on the road from Clanwilliam, 12 November 1948, leg. University California-Transvaal Museum Expedition (140 spec., holo- and allotype in T.M., paratypes in T.M., C.A.Sc. and B.C.M.); Vredental, 30 July 1927, leg. G. van Son (1 paratype, T.M.); Van Rhynsdorp, July to August 1927, leg. G. van Son (9 spec., T.M.); Clanwilliam, September 1928, leg. H. Brauns (4 spec., T.M.); Buffels River near Grootmist, 21 September 1948, leg. University California-Transvaal Museum Expedition (14 spec., T.M.); Wolfberg, 19 November 1948, leg. University California-Transvaal Museum Expedition (2 spec., T.M.).

I was able to compare the new form with typical specimens of *costata*, coming from Victoria West (4 spec., T.M.); Richmond (September 1948, leg. F.W. Wagner, 1 spec., Entomological Department Rhodes University) and Bushmanland (Pofadder and Nabeis, leg. University California-Transvaal Museum Expedition, T.M.).

***Cimicichora crenulata* n. sp.**

(Plate XII, fig. 190)

(For the differential diagnosis of the new genus see key to genera on pages 3-39).

Body sub-circular, convex above, testaceous to brown, with the appendages paler. Head transverse, enclosed in prothorax up to genal angles, on upper surface densely covered with setiferous granules. Apical margin of epistome broadly emarginate at middle, the emargination variable in size and sometimes with a minute dilatation at middle, with the acies slightly reflected. Genae long, strongly dilated towards lateral portions of epistome.

considerably projecting beyond ocular outlines, with the genal canthus dividing eyes into a dorsal and ventral part. Supra-orbital edges developed; the vertex in front of them with two transverse impressions. Labrum reddish brown to testaceous, shiny, impunctate, flat, with the apical margin truncate and cirrous. Mandibles short, apically bifid, normally concealed under epistome. Maxillary palpi small and elongate, with the apical joint fusiform and about twice as long as pre-apical joint. Submentum strongly transverse, flat, strongly dilated from base to apex, with the apical margin broadly emarginate at middle, covered with sparse setiferous granules. Buccal fissure lobes broad, with obtuse apical margin. Gular surface flat, with a depressed infra-orbital dilatation at sides. Antennae short, as long as the head is broad or shorter, small; the shaft-like basal joint almost as long as the following three joints combined; second joint distinctly pedunculate, only a little broader than long and a little longer than the following joints; third joint transverse, a little longer and less broad than the following joints; the following intermediate joints strongly transverse, similar in size and shape; ninth joint a little longer than the previous joint; apical joint about as long as the two preceding joints taken together, a little longer than broad, with the apical margin of the sclerotized part truncate. Pronotum broadest at base, four times as broad as long, with convex disc and foliaceous lateral portions. Anterior margin deeply emarginate; sides slightly rounded and strongly dilated from anterior angles to posterior ones; the latter acute. Base straight, with the median lobe moderately produced backwards, and furnished with a fringe of golden dense bristles. Integument covered with comparatively scattered fine granules on foliaceous portions, more conglomerated and coarser on disc; sides with long cilia, originating from very fine granules along the lateral border of episternum of prosternum. Prosternum raised along midline, carinate anteriorly; intercoxal apophysis narrow, dilated apically, slightly impressed along middle, bent downwards; episternum with a shallow antennal sulcus, well defined only along inner margin; setiferous granulation coarse and rather scattered on prosternum, very fine and confined to lateral portions on episternum. Elytra almost semi-circular, separated from prothorax, leaving exposed the mesothoracic tergite, with the background of cuticula irregularly foveate-punctate, and densely covered with irregular setiferous granules; the latter are as fine as those on foliaceous portions of pronotum. Each elytron along suture with a dense and fine row of granules; the sharp sub-humeral carina composed of extremely dense, minutely serrate-dentate granules, strongly rounded and narrowed towards base, not reaching the latter, and also apically abbreviate, there abruptly ending a short distance from suture; the sub-humeral carina is delimiting the discal convexity of elytra and its declivity towards the

narrow, horizontally flattened submarginal area is very steep, almost perpendicular; the foliaceous submarginal area is comparatively broad basally, becoming gradually narrowed towards apex. The sharp lateral edge densely and minutely serrate-denticulate, furnished with grey long cilia, which are inserted along the lateral border on reflected portions; the cilia are much longer than those on pronotum. Humeral angles pronounced, rather sharply rectangular. Apical declivity slightly concave, with the extreme apex hardly caudate; no epipleural carina. Base approximately as broad as pronotal base or a little broader, shallowly emarginate at middle. Sides subparallel behind humeral angles. Reflected portions very broad, slightly concave, covered with fine setiferous granules, becoming concentrated towards lateral and apical margins. Underside of afterbody covered with fine setiferous granules, concentrated and a little more elevated at middle of the two basal sternites of abdomen, in front of their apical margin, and along the slightly raised sides of the discal portion of metasternum. Mesosternum carinate at middle of basal portion; intercoxal apophysis about one and a half times as broad as prosternal apophysis, with the lateral borders slightly raised and with truncate apical margin. Discal portion of metasternum flattened, with indicated edges laterally. Basal sternite of abdomen as long as metasternum, with the intercoxal process one and a half times as broad as mesosternal apophysis; the two pre-apical sternites with narrow, excavate submarginal area along apical margin. Legs slender. Femora slightly clavate, with smooth underside. Anterior tibiae compressed, with the outer edge denticulate at proximal half, sinuate distally and produced into a large apical tooth, with the apical margin as broad as the anterior tarsus is long. Intermediate and posterior tibiae with flattened outer surface, which is flanked at each side by a longitudinal row of somewhat dentate tubercles, bearing each a stiff and short spine. Calcares of anterior and intermediate tibiae about as long as the three proximal joints of the respective tarsi combined; the longer spur of the calcares of posterior tibiae as long as the two proximal joints of posterior tarsi taken together. Tarsi spinose, much shorter than tibiae; anterior tarsi the shortest. The ungual joint of all tarsi the longest. Claws straight and slightly curved only apically, as long as the ungual joint or a little shorter in the anterior and intermediate tarsi, considerably shorter than that in the posterior tarsi.

**Dimensions:** Length 6 to 7 1/2 mm., width 4 3/4 to 6 mm.

**Locality:** Northern Bushmanland: Aggeneys, 16 December 1948, leg. University California-Transvaal Museum Expedition (22 spec., holo- and allotype in T.M., paratypes in T.M., C.A.Sc. and B.C.M.); same locality, September 1949, leg. C. Koch (8 paratypes in T.M.).

**Habitat:** In the sand of red dunes, under plants and grasses.

**Gimicichora Hessei** n. sp.

(Plate XII, fig. 191)

Differing from *C. crenulata* n. as follows :

Body less convex and darker, blackish to dark reddish brown. Supra-orbital ridges strongly developed, angularly bent inwards in front of eyes, and transversely and straightly produced towards middle of vertex; pre-ocular grooves deeper and more spacious, separated from one another by a short median carinula (in *crenulata* the supra-orbital ridges are confined to the inner margin of eyes, not produced towards middle of vertex; the pre-ocular grooves are shallow and not separated from one another by a carinula). Antennae a little shorter and stouter, but showing the same proportions. Sides of pronotum more rounded and not ciliate; from the fine granules along the lateral margin on episternum of prosternum originate only short bristles, which are not differentiated from those on remaining surface. Granules on discal convexity of pronotum hardly larger than those on foliaceous portions, and less dense than in *crenulata*. Anterior emargination deeper, with the lateral angles more produced. Carina of anterior margin of prosternum obsolete (sharply defined in *crenulata*); intercoxal apophysis more dilated apically, with narrower prolongation towards anterior margin of prosternum. Discal convexity of elytra weaker; in caudal view the contours appear to be flattened at the top and straight across suture (forming a continuous curve in *crenulata*). The sharp lateral edge is smooth, at most widely undulate apically (minutely crenulate or serrate in *crenulata*); cilia of sides much shorter and less dense, distinctly shorter than the longer spur of the calcares of posterior tibiae (much longer than that in *crenulata*). Each elytron with a slight longitudinal impression along suture, most distinct apically (without such an impression in *crenulata*); the subhumeral costa shows a slight tendency to become prolonged apically, as its end curves parallel with suture (whereas its end points towards suture in *crenulata*). Base distinctly broader, than pronotal base, with less sharp humeral angles. The foliaceous submarginal area considerably broader, separated from the outer declivity of subhumeral carina by a somewhat sulcate, coarsely punctured longitudinal impression. Sides broadly rounded apically, without any indication of a caudate apex; the apical declivity, viewed from the side, perpendicular and sharply demarcated from the horizontally flattened marginal area of apex (in *crenulata* the contours of the dorsal convexity, when viewed from the side, are continuous with those of apex). Mesosternal apophysis narrower, only a little broader than the prosternal one; discal portion of metasternum scarcely bordered laterally, and distinctly longer than basal sternite. Legs slenderer, with the outer surface of intermediate and pos-



terior tibiae much narrower, less sharply edged laterally, and with longer spinulae of the dentate rows of tubercles.

Dimensions : Length 6 to 7  $1/4$  mm., width 4  $3/4$  to 6  $1/4$  mm.

Localities : South-western Kalahari : between Twee Rivieren and Witdraai, August 1948, leg. University California-Transvaal Museum Expedition (2 spec., holo- and allotype in T.M.); 22 miles upwards Auob River and Auob-Nossob junction, April 1933, leg. G. van Son (10 paratypes in T.M. and B.C.M.); Stamprietfontein, 3 October 1950, leg. C. Koch and G. van Son (22 paratypes in T.M.).

Habitat : Red sand dunes, in sand under grasses or at the foot of trees, often together with *Stips Gebieni* (Hesse).

I have named the new species in honour of Dr. A.J. Hesse, Entomologist to the South African Museum, as a modest sign of my deep gratitude for his most assistance in my studies.

***Cimicichora gigantea* n. sp.**

(Plate XII, fig. 187)

Sharply differentiated from *C. crenulata* and *C. Hessei* in the following particulars :

Size of body much larger : 8 to 11  $3/4$  mm. long, 6  $1/2$  to 8  $3/4$  mm. broad; on account of the large size much resembling *Stips Gebieni* (Hesse) (cf. plate XI, fig. 186). The sides of body are not ciliate and appear as if bare; the granules of the underside of the foliaceous portions of prothorax and elytra bear only short and adherent bristles, which do not project outwards beyond the lateral edges of the respective parts of body. Head broader, with an obsolete and prolonged median carina, interrupted between the transversely produced supra-orbital ridges; genae much more dilated and strongly projecting outwards. Antennae longer, about as long as the head is broad, with the third joint distinctly longer than second joint, and with the distal joints less transverse (in *crenulata* and *Hessei* the antennae are shorter than the head is broad, with the third joint shorter than the second one or at most as long as that, and with the distal joints more transverse). The disc of pronotum shows on each side of middle two slightly indicated longitudinal convexities, diverging backwards, and appearing as if obsoletely carinate (in *crenulata* these convexities are absent, in *Hessei* scarcely indicated). Elytra much less convex, almost flat, with the apical declivity very slightly and gradually sloping towards apex. The foliaceous submarginal depression is much broader, only slightly narrowed towards apex and remaining still broad around the apex itself; in exact caudal view the horizontal space between lateral edge of elytra and the outer declivity of the subhumeral carina is much broader than the outer declivity of carina is

high (in *crenulata* and *Hessei* the foliaceous submarginal depression is much narrower, becoming strongly narrowed towards apex, there even disappearing altogether in *crenulata*; in caudal view, the horizontal space between the lateral edge and the outer declivity of the subhumeral carina is distinctly narrower than the latter is high in *Hessei*, of only one-third of the height of the outer declivity of carina in *crenulata*). The anterior tibiae are simply dilated towards apex, without showing the strongly projecting apical tooth of the outer angle, which is characteristic for *crenulata* and *Hessei*; the apical margin therefore distinctly narrower than the length of the anterior tarsus. Tibiae slenderer, with the denticulation of the edges of outer surface much more scattered, irregular and more or less granular.

**Locality:** Northern Little Namaqualand : Brandkaross, between the Richtersveld and the mouth of the Orange River, 9 September 1950, leg. C. Koch and G. van Son (19 spec., holo- and allotype in T.M., paratypes in T.M. and B.C.M.).

**Habitat:** In windblown sand and small dunes of the Orange River valley, under plants.

*C. gigantea* is the largest species of the genus, resembling *Stips Gebieni* (cf. plate XI, fig. 186) from the Kalahari; it differs from the latter in the absence of discal carinae on metasternum; basal sternites of abdomen, and pronotum; the more slender and more elongate antennae, the legs and the longer pilosity of the underside of the foliaceous portions of body.

#### REFERENCES

- Ancey, C.F. (1881) : Descriptions de Coléoptères Nouveaux (Le Naturaliste, pp. 468-469).
- Ancey, C.F. (1881a) : Descriptions de Coléoptères Nouveaux (Le Naturaliste, pp. 485-486).
- Erichson, W.F. (1843) : Beitrag zur Insekten-Fauna von Angola (*Arch. Naturgesch.*, IX, pp. 199-267).
- Español Coll, F. (1944) : Nuevos datos para el conocimiento de los Tenebriónidos (Col.) del Sáhara Español ("Eos", *Rev. Esp. Entomol.*, XX, pp. 7-30, 4 figs.).
- Fahraeus, O.I. (1870) : Coleoptera Caffrariae. — Heteromera (*Öfv. Kongl. Vetensk.-Akad. Förhandl.*, No. 4, pp. 243-358).
- Fairmaire, L. (1887) : Coléoptères des Voyages de M.G. Révoil chez les Somâlis et dans l'intérieur du Zanguebar (*Annales Soc. Ent. France*, 6, VII, pp. 69-186).
- Fairmaire, L. (1888) : Énumération des Coléoptères recueillis par M. le Dr. Hans Schinz dans le sud de l'Afrique (*Annales Soc. Ent. France*, pp. 173-202).

- Fairmaire, L. (1891) : Deux Coléoptères nouveaux de la Cafrerie (*Bull. Soc. Ent. France*, pp. LXXXIX-XC).
- Fairmaire, L. (1891a) : Coléoptères de l'Afrique Orientale (*C.R. Soc. Ent. Belgique*, XXXV, pp. CCLXXIX-CCCVII).
- Fairmaire, L. (1893) : Matériaux pour la faune coléoptérologique du Sénégal (*Annales Soc. Ent. France*, LXII, pp. 147-158).
- Fairmaire, L. (1894) : In Eugène Simon, Notes sur les Arthropodes cavernicoles du Transvaal (*Annales Soc. Ent. France*, LXIII, pp. 66-67).
- Fairmaire, L. (1894a) : Coléoptères de l'Afrique intertropicale et australe (*Annales Soc. Ent. Belgique*, pp. 314-335 et 651-679).
- Fairmaire, L. (1894b) : Coléoptères de l'Afrique intertropicale et australe; 3ème note (*Annales Soc. Ent. Belgique*, pp. 451-479).
- Fairmaire, L. (1902) : Coléoptères nouveaux de San Tomé et du Benguela (*Bull. Soc. Ent. France*, pp. 134-136).
- Gebien, H. (1910) : Diagnosen der von Dr. Sheffield Neave im südlichen Kongo-Gebiet gesammelten Tenebrioniden (*Annales Soc. Ent. Belgique*, LIV, pp. 144-182).
- Gebien, H. (1910a) : Wissenschaftl. Ergebnisse Schwed. Zool. Expedition nach dem Kilimandjaro, dem Meru 1905-06 : 7. Coleoptera, 19. Tenebrionidae (Stockholm, pp. 365-397, 16 figs.).
- Gebien, H. (1920) : Käfer aus der Familie der Tenebrioniden, gesammelt auf der "Hamburger deutsch-südwestafri. Studienreise 1911" (*Abhandl. aus d. Gebiet Auslandskunde*, Bd. 5, Reihe C, Band 2, pp. I-VIII and 1-168, 6 maps, 69 figs., 2 plates).
- Gebien, H. (1937) : Über neue Tenebrioniden Ostafrikas aus den Sammlungen des Museo Civico di Storia Naturale di Trieste (*Atti Mus. Stor. Nat. Trieste*, XIV, No. 2, pp. 21-55, 14 figs.).
- Gebien, H. (1937a) : Katalog der Tenebrioniden, Teil I (*Publ. Museo Ent. Pietro Rossi*, Duino, 2, pp. 1-381).
- Gebien, H. (1938) : Die Tenebrioniden Namibwüste in Südwestafrika (*Abhandl. naturw. Verein Bremen*, XXX, pp. 20-107, 30 figs.).
- Gerstäcker, A. (1862) : In Wilhelm C.H. Peters, Naturw. Reise nach Mossambique, Zoologie, V. Insecten und Myriapoden : Paussidae to Chrysomelidae (Berlin, pp. 268-348, 6 col. plates).
- Gridelli, E. (1930) : Risultati zoologici della Missione inviata dalla R. Società Geografica Italiana per l'esplorazione dell'Oasi di Giarabub : Coleotteri (*Annali Museo Genova*, LIV, pp. 1-485, 1 map).
- Gridelli, E. (1939) : Coleotteri dell'Africa Orientale Italiana : XI. Materiali per lo studio della Fauna Eritrea raccolti nel 1901-03 dal Dott. Alfredo Andreini (*Memorie Soc. Entomol. Italiana*, XVIII, pp. 219-258, 12 figs.).

- Haag-Rutenberg, G. (1872) : Monographie der Eurychoriden (*Arch. Naturgesch.*, XXXVIII, pp. 359-428).
- Haag-Rutenberg, G. (1875) : Monographie der Eurychoriden (*Deutsche Ent. Zeitschr.*, XIX, 5. Heft, pp. 359-428).
- Haag-Rutenberg, G. (1878) : Beschreibung neuer Arten von Heteromeren als Nachtrag zu Monographien (*Mitteilg. Münchn. Ent. Verein*, pp. 77-95).
- Hesse, A.J. (1935) : Scientific Results of the Vernay-Lang Kalahari Expedition : Tenebrionidae (*Annals Transv. Mus.*, XVI, Part IV, pp. 525-579, 19 figs.).
- Koch, C. (1935) : Wissenschaftl. Ergebn. Exped. Fürst A. della Torre e Tasso nach Ägypten u. Sinai, VII. Tenebrionidae (*Bull. Soc. Roy. Entom. d'Egypte*, pp. 2-111).
- Koch, C. (1950) : Proposed change of African generic names in the family of Tenebrionidae (*The Entomologist*, LXXXIII, pp. 66-68).
- Koch, C. (1950a) : The Tenebrionidae of Southern Africa, I. First Account Univ. California-Transvaal Mus. Exped. 1948 (*Annals Trans. Mus.*, XXI, Part III, pp. 273-367, 19 plates).
- Lesne, P. (1922) : Voyage de M. le Baron Maurice de Rothschild en Ethiopie et en Afrique Anglaise : Coléoptères Bostrychides, Clérides, Sphindides et Ténébrionides (Paris, pp. 649-704, 12 figs., 10 col. plates).
- Péringuey : L. (1899) : Fifth Contribution to the South African Coleopterous Fauna (*Annals South African Mus.*, I, pp. 240-330, 2 plates).
- Westwood, J.O. (1837) : Description de la *Steira costata* (*Mag. de Zool.*, VII, Cl. IX, No. 176).



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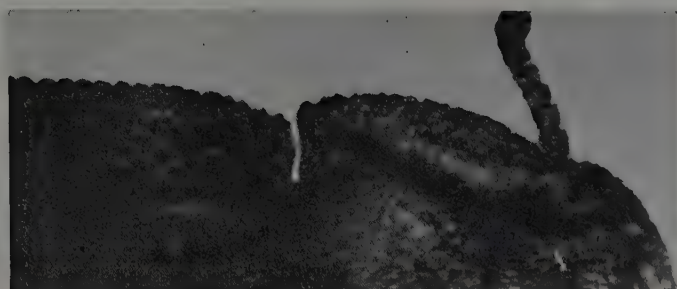


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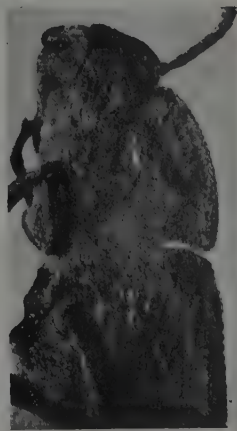
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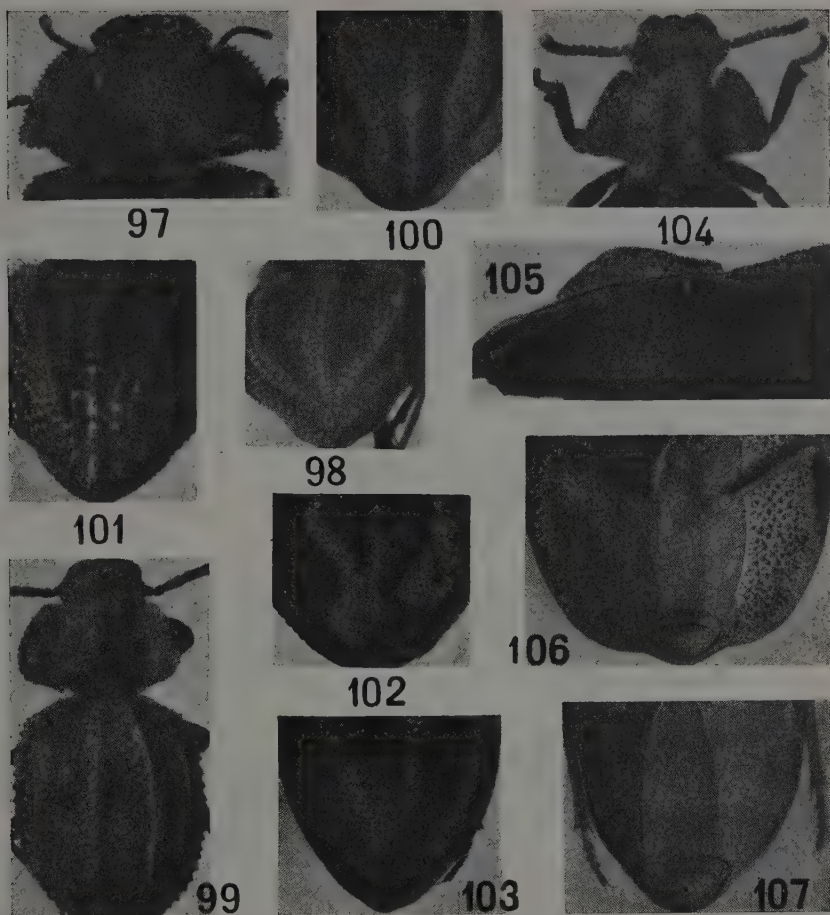


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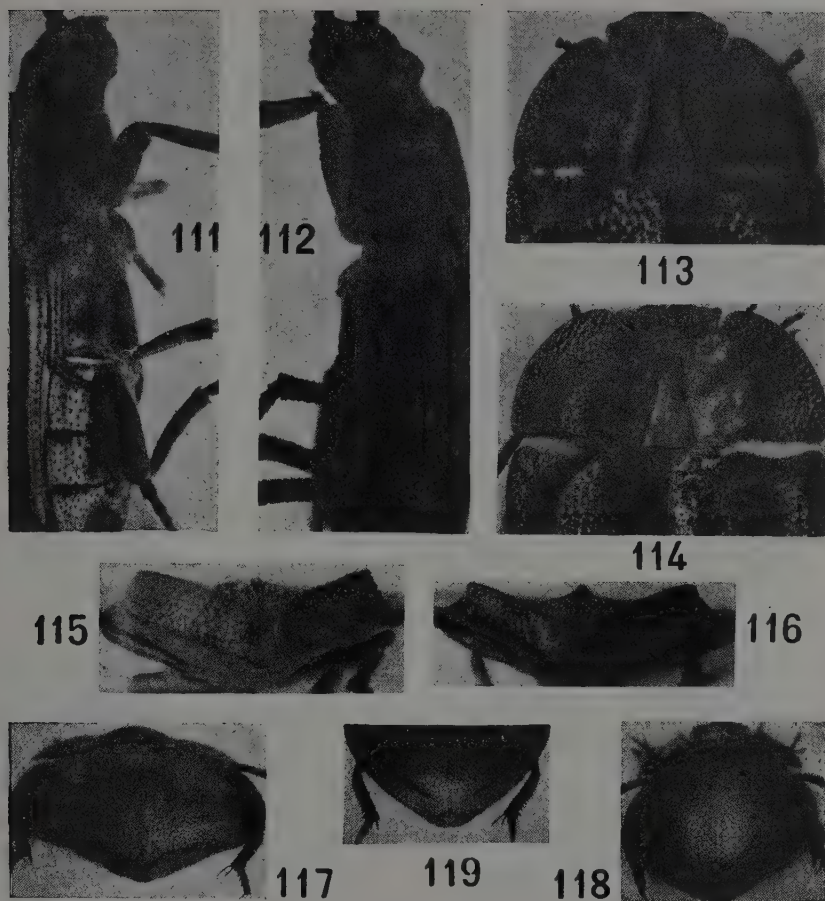


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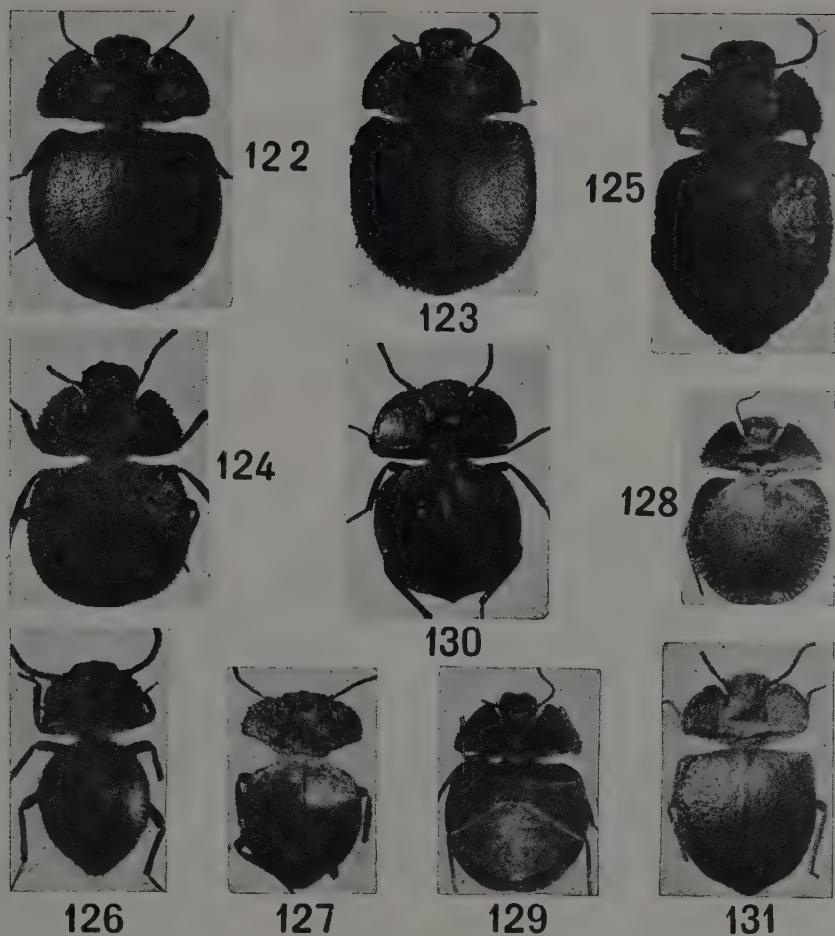


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Fig. 132 : *Serrichora pogonobasoides* n. sp. — Fig. 133 : *Serrichora punctipennis* Simoesi subsp. n. — Fig. 134 : *Serrichora karrooensis* n. sp. — Fig. 135 : *Serrichora Bossmanni* n. sp. — Fig. 136 : *Serrichora longantennata* n. sp. — Fig. 137 : *Pogonobasis (Peristeptus) Pinheyi* n. sp. — Fig. 138 : *Serrichora Langi* n. sp. — Fig. 139 : *Symphochora humerifera* (Geb.).



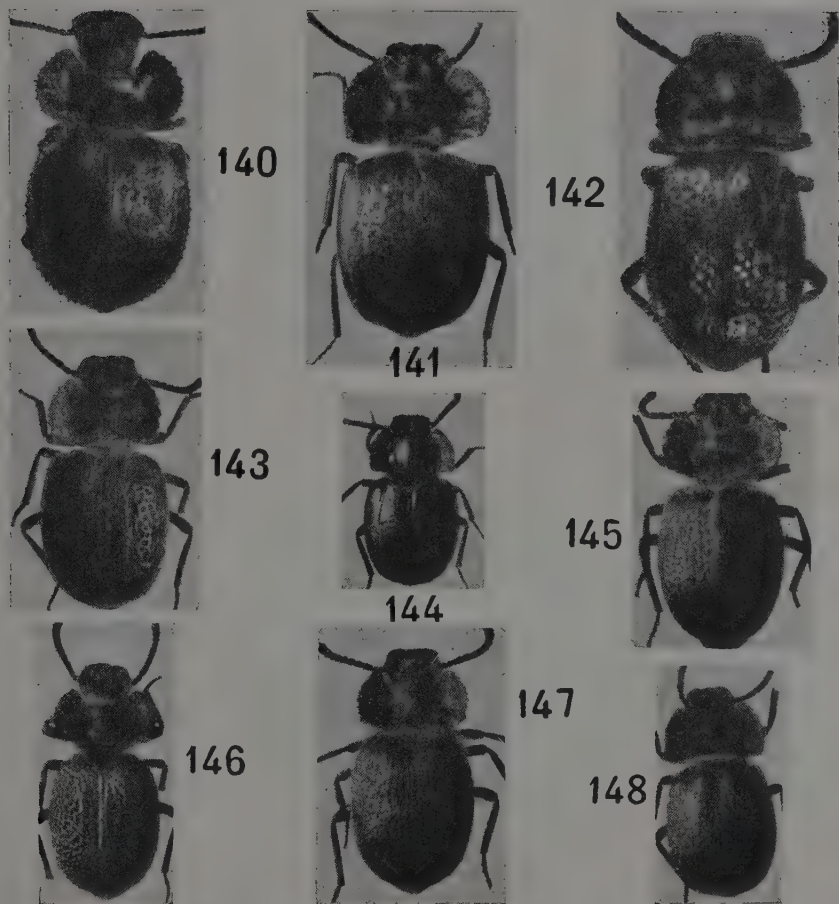


Fig. 140 : *Pogonobasis (Peristeptus) gracilicornis* n. sp. — Fig. 141 : *Pogonobasis (Peristeptus) armata* n. sp. — Fig. 142 : *Pogonobasis (s. str.) submarginata* n. sp. — Fig. 143 : *Pogonobasis (s. str.) denticollis* n. sp. — Fig. 144 : *Pogonobasis (Peristeptus) bisulcata* n. sp. — Fig. 145 : *Pogonobasis (s. str.) denticollis rukwana* subsp. n. — Fig. 146 : *Pogonobasis (s. str.) bisinuata* n. sp. — Fig. 147 : *Pogonobasis (s. str.) senegalensis* n. sp. — Fig. 148 : *Pogonobasis (Peristeptus) tangana* n. sp.





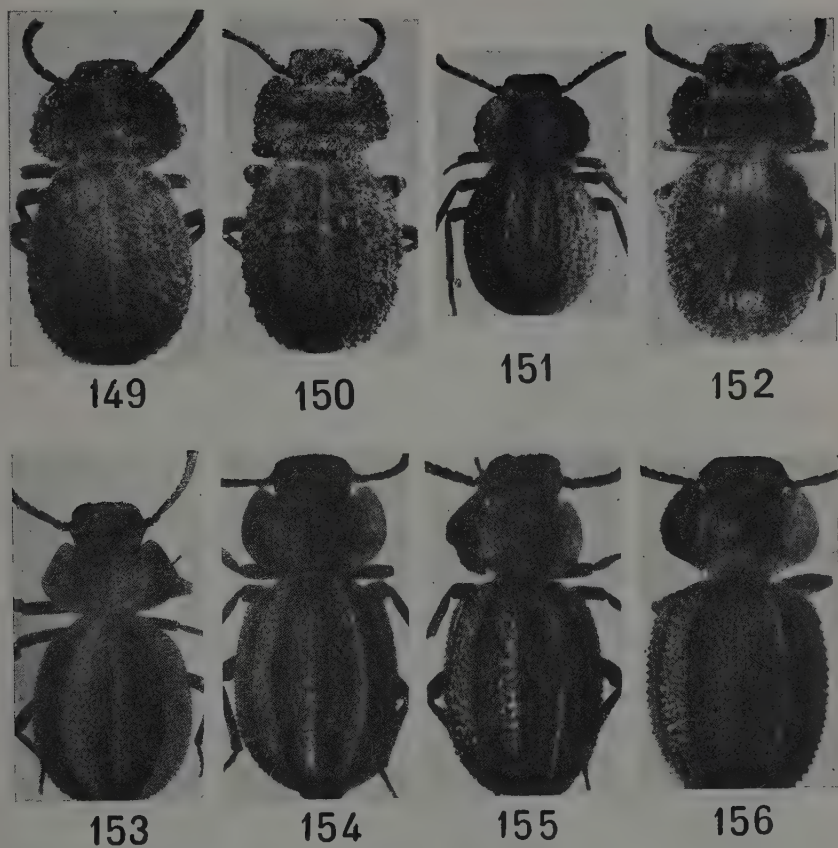


Fig. 149 : *Pogonobasis* (s. str.) *nigrosetosa* n. sp. — Fig. 150 : *Pogonobasis* (s. str.) *distincta* n. sp. — Fig. 151 : *Pogonobasis* (s. str.) *nigrosetosa sandoana* subsp. n. — Fig. 152 : *Pogonobasis* (s. str.) *brevicornis* n. sp. — Fig. 153 : *Prunaspila carinicollis* n. sp. — Fig. 154 : *Prunaspila transvaalensis* n. sp. — Fig. 155 : *Prunaspila Arnoldi* n. sp. — Fig. 156 : *Prunaspila bicostata* (Westw.), f. t.



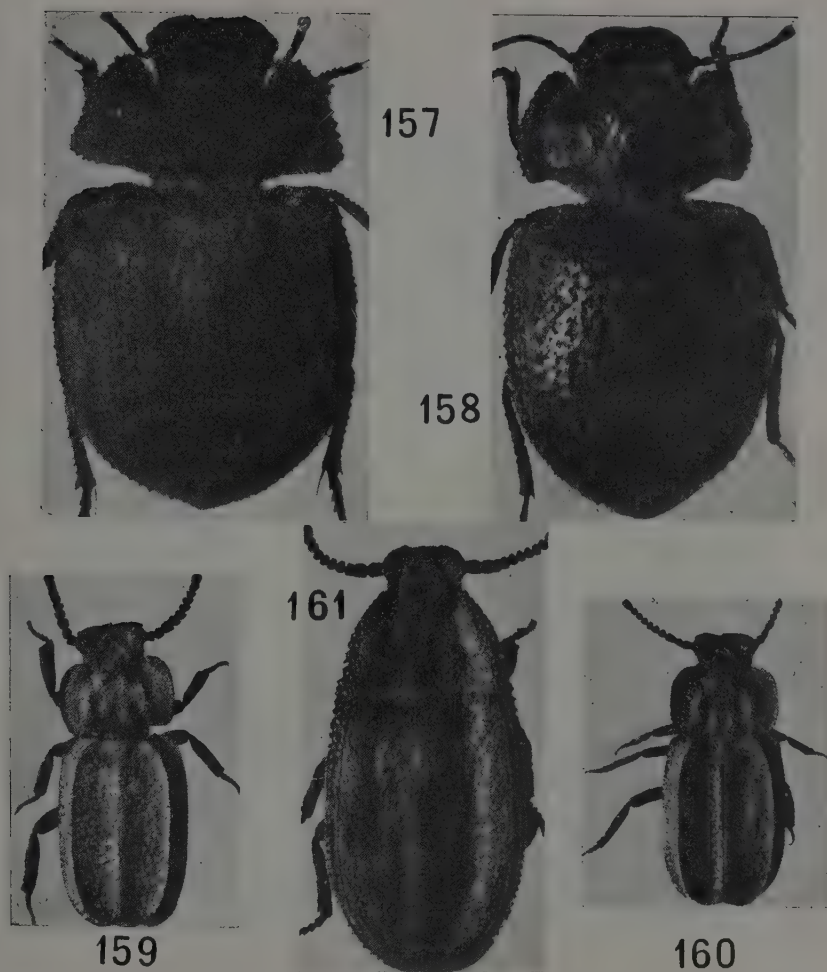


Fig. 157 : *Cimiciopsis Castleae* n. sp. — Fig. 158 : *Pogonocanta longipilis* (Fairm). —  
 Fig. 159 : *Smiliophanus steiroides* (Haag). — Fig. 160 : *Smiliophanus Vansoni* n. sp. —  
 Fig. 161 : *Argasidius squamosus* Pering.





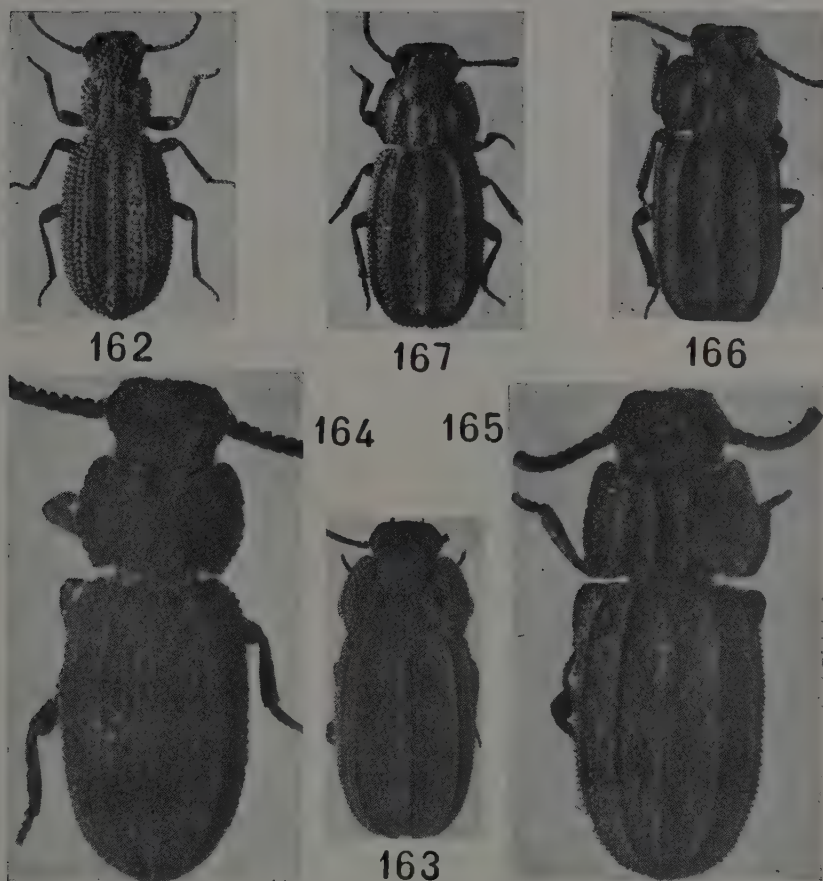


Fig. 162 : *Eutichus Wahlbergi* (Haag). — Fig. 163 : *Platyphanus similis* (Haag). —  
 Fig. 164 : *Psaryphis nana* Erichs. — Fig. 165 : *Platysemodes benguelensis* (Haag). — Fig. 166 :  
*Acestophanus elongatus* (Haag). — Fig. 167 : *Acestophanus kaokoanus* n. sp.



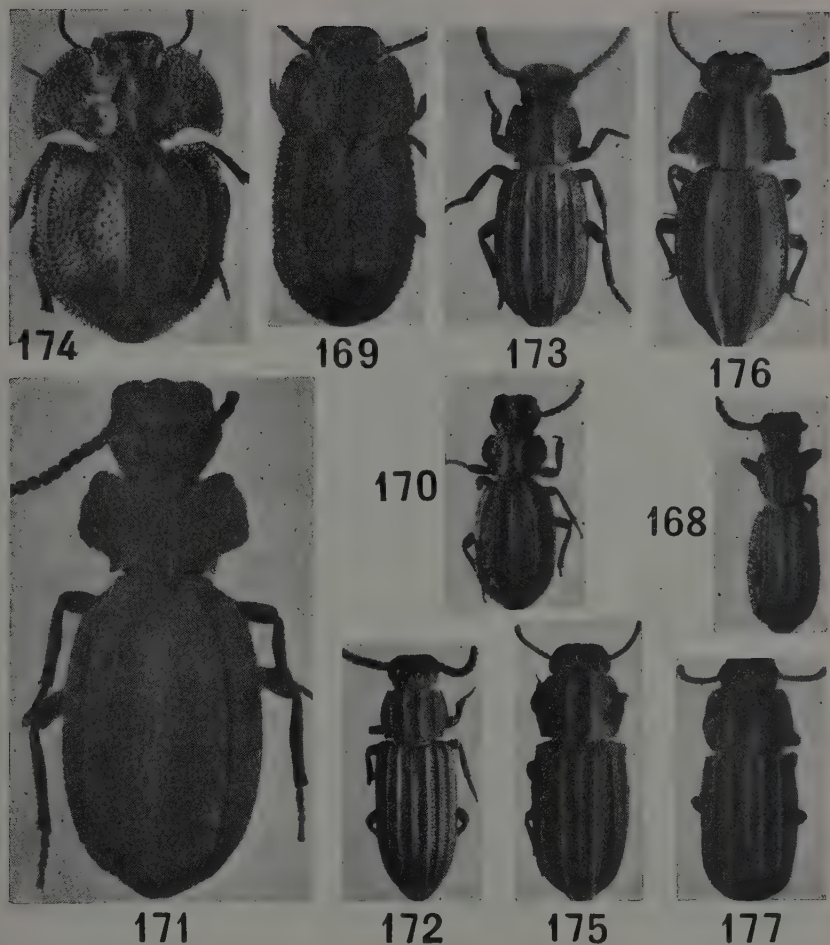


Fig. 168 : *Herpsis rugosus* (Gory). — Fig. 169 : *Geophanus pygmaeus* (Erichs.). — Fig. 170 : *Falsaspila abyssinica* (Haag). — Fig. 171 : *Falsaspila Batesi* (Haag). — Fig. 172 : *Basilewskyum stenosinoide* n. sp. — Fig. 173 : *Adelostoma sulcatum* Dup. — Fig. 174 : *Machlopsis crenatocostata* (Redtb.) — Fig. 175 : *Psaryphulum Machadoi* n. sp. — Fig. 176 : *Psaryphulum damara* n. sp. — Fig. 177 : *Psaryphulum abbreviatum* (Haag).





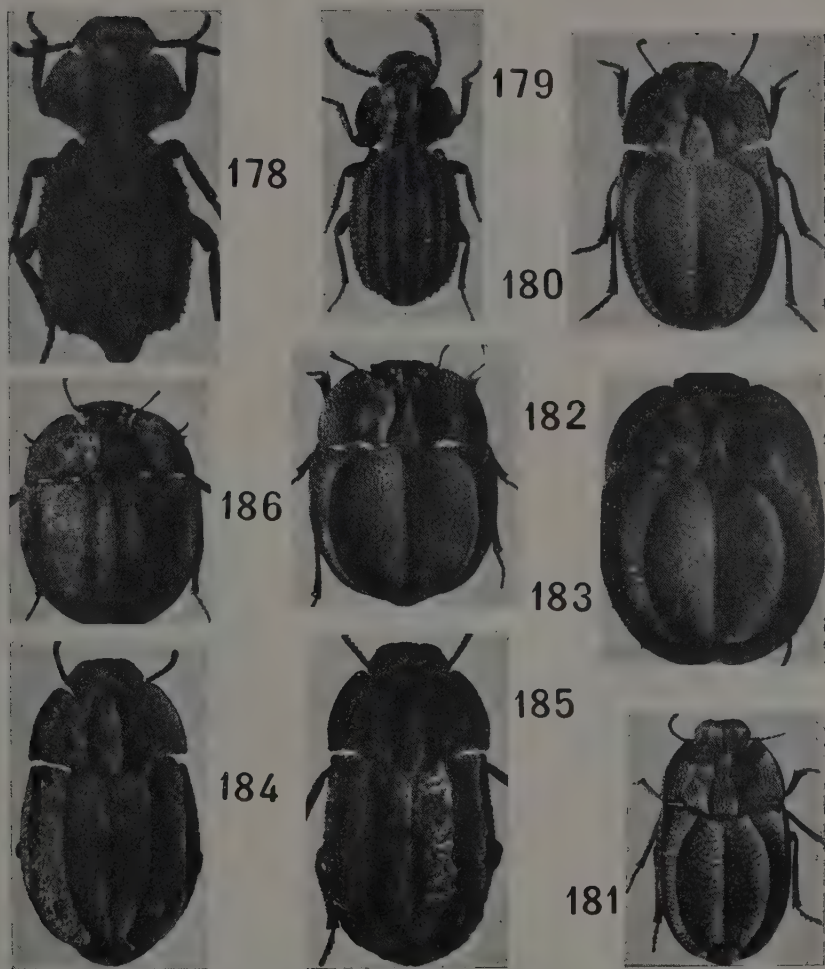


Fig. 178 : *Aspilomorpha mediolobata* n. sp. — Fig. 179 : *Aspilomorpha Alfieri* n. sp. — Fig. 180 : *Stipsostoma holgatensis* n. sp. — Fig. 181 : *Stipsostoma sculpta* (Geb.). — Fig. 182 : *Stips costata grandis* subsp. n. — Fig. 183 : *Stips Dohmi* (Haag). — Fig. 184 : *Phytolostoma limpopoana* n. sp. — Fig. 185 : *Phytolostoma limpopoana whellani* subsp. n. — Fig. 186 : *Stips Gebieni* (Hesse).





Fig. 187 : *Cimicichora gigantea* n. sp. — Fig. 188 : *Stips cassidioides* (Geb.). — Fig. 189 : *Stips dorsocostata* (Fairm.). — Fig. 190 : *Cimicichora crenulata* n. sp. — Fig. 191 : *Cimicichora Hessei* n. sp. — Fig. 192 : *Stips Stali* (Haag). — Fig. 193 : *Cimicia spinipes* Fairm., dorsal aspect.







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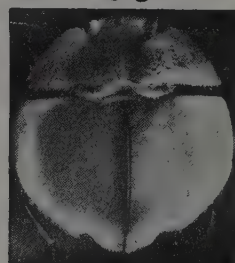
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Fig. 194 : *Cimicia spinipes* Fairm., - ventral aspect. — Fig. 195 : *Arthrochora arenicola* Geb., dorsal aspect. — Fig. 196 : *Arthrochora arenicola* Geb., ventral aspect. — Fig. 197 : *Lepidochora pilosa* Koch. — Fig. 198 : *Lepidochora diaphana* Koch. — Fig. 199 : *Lepidochora Eberlanzi* Geb. — Fig. 200 : *Lepidochora diaphana* Koch.



# Neue Kleinschmetterlinge aus Syrien

(mit 11 Abbildungen)

von Dr. H.G. AMSEL (Buchenberg/Baden)

## Pyralidae

### *Heterographis damascenella* sp. n.

*Spw.* 16-18 mm. *Vfgl.* gelbbraun. *Costa*, 2 Querbinden und der Zellschluss-Fleck weiss, letzterer in Verbindung mit der Costalstrieme. Saum schmal verdunkelt. Hinterflügel grau.

Die sehr charakteristisch gezeichnete Art gehört in die Verwandtschaft von *faustinella* Z., deren Zeichnungsprinzip sie weitgehend besitzt. Bei *faustinella* fehlt aber der weisse Zellschlussfleck, auch ist der Verlauf der Binden etwas abweichend.

Die Grundfarbe der *Vfgl.* ist bei *damascenella* etwas gelblicher, ausserdem fallen einige rötlichgraue Schuppen auf, die besonders längs der unteren Zellgrenze und auf der *ar* gehäuft sind und einen leichten metallischen Schimmer tragen. Der Saum ist ganz schmal grau-schwärzlich. Die Fransen sind grau bis weisslich mit Basallinie. Die *Costa* ist in ihrer ganzen Länge weiss, ziemlich scharf gegen die Flügelfläche hin abgegrenzt und im Mittelfeld etwas breiter als nach der Basis hin. Dadurch, dass der weisse Zellschlussfleck mit der *Costa* in Verbindung steht, erscheint die Costalstrieme hier am breitesten. Die 2. Binde ist ganz grade oder ganz schwach konkav gebogen, sie geht dem Saum fast parallel und mündet unmittelbar vor dem Innenwinkel. Die 1. Binde steht fast senkrecht auf der *Costa* und erreicht den Innenrand bei  $1/3$ . Die Hinterflügel sind grau, Fransen wie auf den *Vfgl.*, nur etwas heller. Thorax wie die *Vfgl.*, Hinterleib etwas heller. Fühler des ♂ ganz schwach bewimpert, Stirn kugelig abgerundet, Palpen weisslich, aufgebogen.

Im *Vfgl.* kommen *m2* und *m3* aus einem Punkt. Die Art gehört also eindeutig zu *Heterographis* und nicht zu *Trissonca*, die durch lang gestielte *m2* und *m3* ausgezeichnet ist.

Genitalapparat des ♂ (Fig. 1) : Uncus sehr schmal und spitz. Gnathos breit, abgerundet. Valven sehr schmal, parallelerandig, ohne jede Auszeich-

nung. Vinculum breit abgerundet. Aedoeagus schmal stabförmig, grade, ohne Auszeichnungen. Coremeta einfach. GU 1514.

Fundort : Damascus, 29. v, 1 ♂ ♀.

**Heterographis latakiella sp.n.**

Spw. 16-17 mm. Vfgl.-Grundfarbe braunschwarz, mit weissen Schuppen mehr oder weniger überdeckt. Die beiden hellen Querlinien unscharf. Hinterflügel grau. Fühler des ♂ pubescent. Palpen überwiegend weiss, schwach dunkel gefleckt.

Die sehr dunkle Grundfarbe ist durch die weissen Schuppen weitgehend verdeckt. Das Mittelfeld kommt nur schwach zur Geltung. Die beiden Querlinien sind unbestimmt. Die äussere, dem Saum parallel, stärker gezackt oder aber diffus aufgelöst, erreicht den Innenrand bei  $\frac{4}{5}$ , also deutlich vor dem Innenwinkel. Fransen wie die Vfgl. Hinterflügel grau, Fransen heller, mit Basallinie. Die Palpen sind vorgestreckt bzw. aufgebogen, überwiegend weiss, mit einigen dunklen Schuppen.

Genitalapparat des ♂ (Fig. 2) : Uncus spitz. Gnathos am Ende etwas nach oben aufgebogen, was nur in Lateral-Ansicht sichtbar ist Valven parallelrandig, ohne Auszeichnungen. Innenrand bis zur Mitte schwach verstärkt. Vinculum viereckig, die Ecken abgerundet. Aedoeagus relativ lang, sehr dünn. Coremeta-Platte ellipsoid.

Fundort : Latakia, 22.viii, 1 ♂ ; Hama, 16.viii, 1 ♀.

Die Art kann wohl am besten bei *dumetella* Rag. eingereiht werden, ist aber viel kleiner als diese.

**Bostra homsalis sp. n. (Fig. 3, 4).**

Spw. 18 mm. Vfgl. braun-rötlich, beide Querbinden ziemlich dicht beieinander und undeutlich, Fransen grau. Hinterflügel mit schwach entwickelter Mittelbinde, Randpartie mehr graubräunlich. Fransen bis zur Mitte grau, Endteil gelblich. Fühler des ♂ bewimpert, Länge der Wimpern von der Breite des Schaftes. Palpen schräg nach vorn unten hängend,  $1\frac{1}{2}$  mal so lang wie der Augendurchmesser.

Die kleine Art steht ziemlich isoliert und gleicht keiner bisher beschriebenen Art näher. Die bräunlichen Vfgl. zeigen eine schwache Tendenz ins Rötlichbraune. Die beiden undeutlichen Querlinien stehen ziemlich dicht beieinander, viel dichter als bei *syriacalis* Rag. und haben einen ganz anderen Verlauf. Die äussere Querbinde geht leicht geschwungen dem Saum parallel und ist von diesem ebenso weit entfernt wie von der 1. Binde, die ihrerseits von der 2. Binde wieder ebenso weit entfernt ist wie von der Flügelwurzel. Der Innenrand des Vfgl. wird also durch die beiden Binden in 3 gleiche Teile geteilt. Die 1. Binde ist am Unterrand der Zelle gewinkelt und steht senkrecht auf der Costa. Alles dieses ist aber sehr unscharf, wie auch die



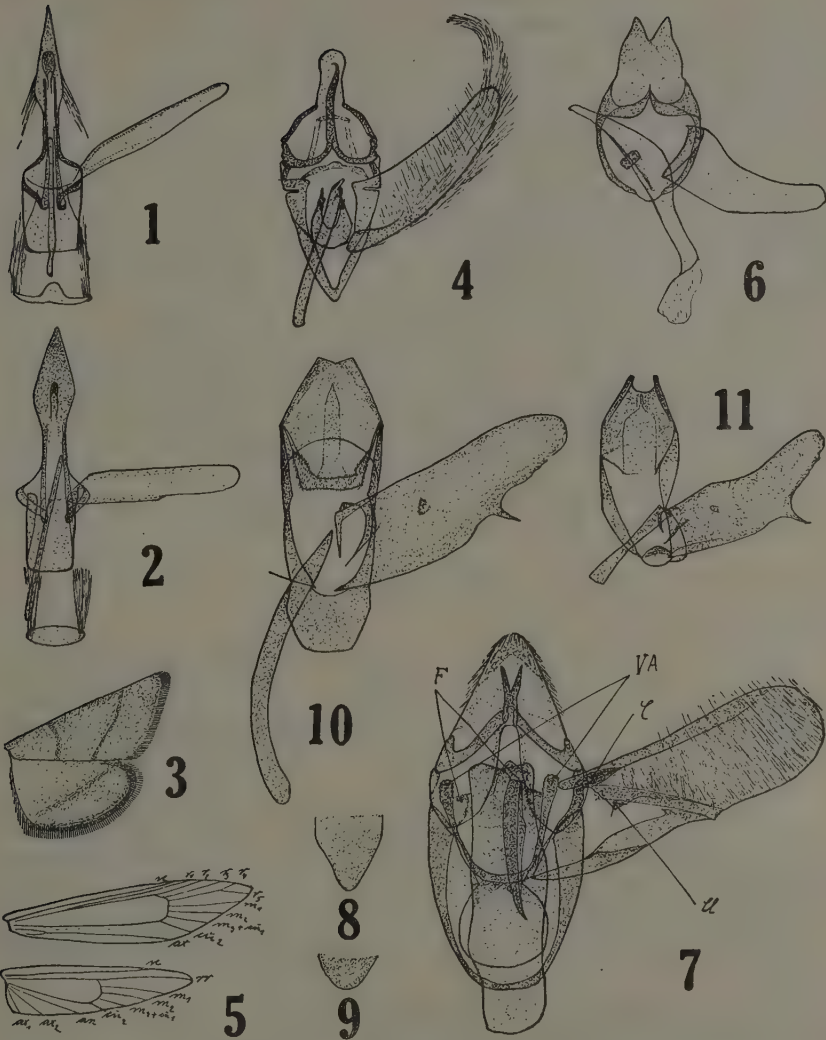


Fig. 1 : *Heterographis damascenella* Ams., Typus, GU.1514. — Fig. 2 : *Heterographis latakiella* Ams., Typus, GU.1515. — Fig. 3 : *Bostra homsalis* Ams., Typus. — Fig. 4 : *Bostra homsalis* Ams., Typus. — Fig. 5 : *Rhipidocera monotona* Ams., Typus. — Fig. 6 : *Rhipidocera monotona* Ams., Typus. — Fig. 7 : *Myelois multiforella* Rag., GU.1513. — Fig. 8 : *Chersis casanella* Ev., Vinculum in Ventral-Ansicht, GU.1516. — Fig. 9 : *Chersis syriaca* Led., Vinculum in Ventral-Ansicht, GU.1521, ex Homs. — Fig. 10 : *Chersis palästinella* Rbl., ex Dagania, See-Genezareth, GU.1520. — Fig. 11 : *Chersis paradoxella* Stgr., ex Albaracin, GU.1519.

5 oder 6 Costalfleckchen nur wenig zwischen den beiden Querlinien auffallen. Der Saum ist unmittelbar neben den Fransen mehr grau, die Fransen selbst sind grau, die Spitzen etwas mehr gelblich. Die Mittelbinde der Hinterflügel ist sehr undeutlich, genau in der Mitte des Flügels. Die Fransen sind hier scharf in den grauen basalen und den gelblichen Aussenteil unterteilt. Thorax und Schulterdecken wie die Vfgl. Die Aussenseite der Palpen wie die Vfgl.-Farbe, die Innenseite mehr gelblich. Die Beine sind zeichnungslos gelblich-grau. Unterseits sind die Vfgl. und Hinterflügel übereinstimmend gelblich-grau, glänzend. Die 2. Querbinde und die Mittelbinde der Hinterflügel sind deutlich. Die Costa der Vfgl. trägt auch hier 5 kleine Fleckchen.

Genitalapparat des ♂: Uncus doppelt so lang wie breit, das Ende halbkreisförmig abgerundet. Gnathos nicht ganz bis zum Uncus-Ende reichend. Valven sehr stark behaart und beschuppt, nach aussen zu etwas schmaler werdend. Vinculum dreieckig zulaufend, Aedoeagus stabförmig, vorderes Ende mit kleinen Chitin-Verstärkungen. Anellus tief ausgehöhlt, der obere Teil des Randes gezackt bzw. mit Stacheln.

Fundort: Homs, 30.viii, 1 sehr gut erhaltenes ♂.

### Gelechiidae

#### **Rhipidocera n. gen. (Fig. 5).**

Fühler des ♂ symmetrisch doppelfiedrig, sehr lang gefiedert. Palpen hängend, anliegend beschuppt, letztes Glied  $1/3$  des 2., wenig abgewinkelt. Zunge klein. Vfgl. schmal, Costa ganz schwach gebogen, Innenrand in den Aussenrand ohne Winkel übergehend.

Geäder: Zelle bis  $2/3$  reichend, *sc* auf der Höhe des Zellschlusses in die Costa; *r1* sehr weit wurzelwärts entspringend, *r2* von der oberen Zellecke, *r4+5* lang gestielt, die Spitze umgreifend; *m1* bis *cu2* in ziemlich gleichen Abständen, *m3* und *cu1* zusammenfallend; *cu2* fast grade; *ax* mit kleiner Wurzelschlinge. Hinterflügel ziemlich schmal, Zelle ziemlich breit; *m1* bis *cu2* in gleichmässigen Abständen entspringend, *m3* und *cu1* zusammenfallend.

Die neue Gattung steht sehr isoliert, sie kann wohl am besten bei *Pterolonche* Z. eingereiht werden.

Typus: *Rh. monotona* sp. n.

#### **Rh. monotona sp. n. (Fig. 6).**

Spw. 19 mm. Vfgl. zeichnungslos braun, Zellschlusspunkt kaum angedeutet, die Adern unmerklich dunkler angelegt. Hinterflügel graubraun.

Die Art ist vor allem durch die ganz auffallenden doppelfiedrigen Fühler des ♂ bemerkenswert. Das 1. Glied ist verbreitert und verdickt,

deutlich länger als breit, das 2. Glied ist ganz kurz und vom 3. ab setzt die Befiederung ein. An jedem Glied sitzt eine lange, schwarze Borste, die ihrerseits wieder allseitig bewimpert ist. Da die einzelnen Glieder ziemlich lang sind, beträgt die Gesamtzahl der Borsten einer Reihe nur etwa 30. Die längsten Borsten in der Mitte des Fühlers sind etwa so lang wie das 2. Palpenglied. Die Beine sind ganz zeichnungslos, die Hinterschienen anliegend lang behaart. Die Flügel-Unterseiten sind gleichmässig graubraun, die Fransen der Hinterflügel an ihrer längsten Stelle von der Flügelbreite.

Genitalapparat des ♂ : Uncus tief gespalten, zweilappig. Gnathos sehr kurz, aber die Basis sehr kräftig. Valven ohne Auszeichnung, Costa eingebuchtet, Innenrand leicht gebogen. Basis der Valven etwa doppelt so breit wie das Ende. Aedoeagus hinter der Mitte gebuckelt. Vinculum sehr klein.

Fundort : Homs, 21.viii, 1 ♂.

Neben diesen neuen Arten, die mir Herr A.S. Talhouk liebenswürdigerweise zur Bearbeitung zusandte, liegen in den Ausbeuten noch folgende alte Arten vor :

***Crambus cyrenaicellus* Rag.**

Hassakeh, 9.xi.

Neu für Syrien! War bisher aus Marocco, Mauretanien, Tripolis, Palästina und Mesopotamien bekannt.

***Ancylolomia syriaca* Rbl.**

Azr'a, 2.xi.

***Heterographis subcandidatella* Rag.**

Damascus, 28.v.-12.iv.

***Auxacia bilineella* Rag.**

Damascus, 20.vi.

Neu für Syrien! War bisher aus Armenien, Tura, Fergana und Mesopotamien bekannt.

***Euzophera lunulella formosella* Rbl.**

Latakia, 12.vi, Tartouss.

Neu für Syrien. Die Nominatform ist im Mittelmeergebiet weit verbreitet, die Unterart *formosella* ist aus Kuldscha, vom Embafluss, Inderskysee, Belutschistan, Persien und Mesopotamien bekannt geworden.

***Phycita pedisignella* Rag.**

Latakia, 13.iv.

Bisher aus Amasia, Ankara und Beirut bekannt.

***Acrobasis obtusella ottomana* Car.**

Damascus, 28.v.

**Rhodophaea dulcella Z.**

Damascus, 17.vi.-25.vi.

**Salebria dionysia Z.**

Damascus, 21.viii, 28.ix.

Die in den afrikanischen Tropen, im Mittelmeergebiet und in Zentralasien weit verbreitete Art war in Syrien bisher nicht aufgefunden.

**Candiope uberalis Swinh.**

" Damascus, 12.vii.

**Myelois multifoarella Rag.**

Damascus, 17.v, Aleppo, 12.v.

Zwei ♂♂ stimmen mit der Originalbeschreibung Ragonot's bis in alle Einzelheiten überein, lediglich die viel bedeutendere Grösse der Stücke von 34 und 36 mm. gegenüber 21 mm. der Type und die helleren Hinterflügel weichen ab. Trotz dieser auffallenden Grössen-Unterschiede möchte ich die Stücke für *multifoarella* halten, da bei den Arten der *Cribrella*-Gruppe die Grösse erheblichen Schwankungen unterworfen ist.

Der Genitalapparat des ♂ (Fig. 7) ist ausgezeichnet durch: (1) schwach vorgezogene Spitze des Innenrandes der Valve, (2) sehr kräftigen Clasper (Cl.), (3) starke Verdickung des basalen Teiles der Costa (C), (4) fein gezackte Enden des ventralen Anellus (VA), (5) gezackte Ränder des Innenteiles des Anellus (F), (6) unentwickelten dorsalen Teil des Anellus, (7) grossen langen Cornutus, der halb so lang wie der Aedoeagus ist. Die Unterschiede gegenüber den nächstverwandten Arten sind (vergl. Amsel, Die Microlepidopteren der Brandt'schen Iran-Aubeute, in: *Ark. f. Zool.*, Ser. 2, Bd. 1, Nr. 36, pp. 542-544, Fig. 28-31 und 69, 1951):

*Constans* Ams. hat einen sehr ähnlich entwickelten Innenrand der Valve und steht hierin *multifoarella* am nächsten. Aber die vorgezogene Spitze direkt hinter der Mitte des Innenrandes ist bei *constans* noch viel ausgeprägter, der Clasper fehlt dieser Art, die Cornuti sind ganz abweichend und der dorsale Teil des Anellus ist normal entwickelt. *Conformella* Ams. stimmt in der Rückbildung des dorsalen Teiles des Anellus mit *multifoarella* überein, hat aber einen ganz anderen Innenrand der Valve, indem hinter der Spitze dieser tief eingebuchtet ist und im Bogen zum Aussenrand führt. *Cribrella* Hb. ist durch glatten Innenrand der Valven, normale Entwicklung des dorsalen Anellus und kleinen, plumpen Cornutus ausgezeichnet. *Britannicella* Ams. ist wie *cibrella*, aber einer der beiden Cornuti ist gezackt.

**Constantia colchicalis H.-S.**

Damascus, 1.x, Der Ezzor, 2.ix.

**Cledeobia isthmicalis Led.**

Azr'a, 15.v.

**Prochoristis rupicapralis Led.**

Aleppo, 10.vi.

**Eudiotis indica Sd.**

Latakia, 17.ix.

Neu für Syrien ! Aus dem paläarktischen Gebiet war diese altweltliche Tropenart bisher nur von den Canarischen Inseln und vom Ussuri bekannt.

**Pyrausta cespitalis intermedialis Dup.**

Damascus, 12.vii.

**Pyrausta meridionalis Stgr.**

Damascus, 2.vi.

**Pyrausta nubilalis Hb.**

Tartouss, 20.viii.

**Cornifrons ulceratalis Led.**

Der Ezzor, 14.xi.

**Aeschremon disparalis H.-S.**

Homs, 1.vi.

**Tortricidae**

**Semasia labyrinthicana Chr.**

Der Ezzor, 7.xi.

Die schöne Art ist neu für Syrien. Bisher war sie nur aus Mittelasien, Sarepta, Taganrog, Stavropol, Uralsk, Rumänien bekannt.

**Gelechiidae**

**Ethmia pusiella Röm.**

Damascus, 2.x.

Die subspezifische Zugehörigkeit des einzigen vorliegenden Stückes bleibt noch unklar.

**Tineidae**

**Chersis (Deuterotinea Rbl.) syriaca Led.**

Homs, 29.xii, drei ♂♂ von 26 mm. Spw. gehören genitaliter zu dieser Art.

Es muss aber bemerkt werden, dass die Genitalien von *casanella* Ev., *syriaca* Led. und *palästinella* Rbl. so ähnlich sind, dass man im Zweifel sein kann, ob es sich hier um 3 bonae species, oder nur um Unterarten der *casanella* handelt. Von *casanella* liegt mir leider nur 1 ♂ aus Süd-



Russland (Ascania-Nova, det. Gerasimov) vor. Spw. 22 mm. GU. 1516. (Fig. 8) Nach diesem Präparat zu urteilen ist der Uncus schwach eingebuchtet wie bei *palästinella* und *syriaca* (Fig. 9, 10) dagegen das Vinculum relativ lang und zugespitzt abgerundet. *Syriaca* hat ein kürzeres Vinculum, *palästinella* (ex Daganian, See Genezareth) ein bedeutend grösseres, auch einen grösseren und stärker gebogenen Aedoeagus. Ich bemerke jedoch, dass bei 3 Präparaten von *syriaca*, die Form des Vinculums etwas schwankte, ferner war die Valvenform und die Gestalt des Innenrand-Dornes der Valve einmal zugespitzt, das andere mal abgerundet, auch die Länge der Aedoeagi war nicht ganz übereinstimmend. Es zeigte sich also schon bei nur 3 Präparaten eine deutliche Variationsbreite der Armaturen. Da Serien von *Chersis*-Arten von den verschiedenen Fundorten nicht vorliegen, kann zunächst nicht entschieden werden, wie gross die individuelle bzw. die subspezifische Variation ist. Vorläufig erscheint es zweckmässig, die 3 Arten weiterhin als *bonae species* zu betrachten.

Die Fühler- und Palpenbildung ist bei allen Arten die gleiche, die Zeichnungen sind so ähnlich, dass ein greifbarer Unterschied nicht gefunden werden kann. Da überdies die *Chersis*-Arten stark variieren (worauf Joannis in *Bull. Soc. Ent. Fr.*, 1917, pp. 259-262, für die spanische und westmediterrane *paradoxella* Stgr. aufmerksam machte) so muss in der Tat mit der Möglichkeit gerechnet werden, dass die 3 ostmediterranen Arten sich als Unterarten der *casanella* erweisen werden.

*Paradoxella* Stgr. ist genitaliter (Fig. 11) deutlich verschieden von den ostmediterranen Arten. Der Aedoeagus ist in der Mitte verjüngt, der Uncus tief eingebuchtet, also ausgesprochen zweizipflig, wobei jeder Zipfel wesentlich höher als breit ist, das Vinculum ist dorsal umgebogen, der Aussenteil der Valve erheblich schmäler als der basale Teil usw.

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# Lepidoptera recently taken in Arabia

(with 5 Text-Figures and Plate)

by E.P. WILTSHIRE, F.R.E.S.

The Lepidopterous fauna of the Arabian sub-continent is still so little known that the publication of any collection made there, if of some size and carefully studied, must be of great interest both faunistically and as regards evidence of migrations and is also sure to contain various species new to science. No apology therefore is needed in presenting below a list, with data, of the species taken at scattered points throughout the whole sub-continent during the forties by the officers of the Middle East Anti-Locust Units (M.E.A.L.U.), under the direction of B.P. Uvarov, C.M.G., D.Sc. To this material have been added lepidoptera from my own collection taken by myself or Mrs. Violet Dickson in and around Kuwait in 1943-1944, but it is regretted that it was impossible to complete the list by including the material in the British Museum collected by H. St. J. Philby and others between the first and second World Wars.

## NATURAL ZONES AND VEGETATION

I am indebted to Mr. George Popov, who worked in the M.E.A.L.U. and now is a member of the Desert Locust Survey, for the following geographical details :

Arabia can be divided into the following natural zones :

1. The Western Coast.
2. Hejaz, i.e. the western range of mountains north of parallel 20° N.
3. Asir and Yemen, i.e. the highlands south of parallel 20° N.
4. The southern coast and Dhofar.
5. Central Arabia, which includes the two great deserts, the Nefud and the Rub'-el-Khali and also the isolated mountain blocks of Jebel Shammar and Jebel Tuwaiq.
6. The Eastern coast.
7. The mountains of Oman.

1. The Western coast is a narrow strip of land lying between the western range of mountains and the sea. It presents a series of well-defined, if narrow, ecological belts :

(a) (nearest the sea) Halophytic belt (characterised by *Suaeda*, *Halo-peplis*, *Aeluropus*, etc.).

(b) *Acacia*, *Salsola*, and other salt-bushes.

(c) Belt of sands with *Panicum* grass.

(d) Foothills, characterised by *Acacia*, *Indigofera*, etc.

These belts are crossed at right angles by wadis (water-courses); the vegetation of these wadis, in order from coast to hills, is characterised by *Suaeda*, *Tamarix*, *Zizyphus*, and *Ficus*, sometimes forming dense growths.

The rainfall regime of this zone is mediterranean, but scanty.

2. The mountains of Hejaz reach a height of about 8000 feet near Taif (just south of the Tropic) but are considerably lower further north. The vegetation is mainly desert thorn-scrub, e.g. *Acacia*, *Lycium*, etc., and very scanty. The range becomes higher again in the extreme north, where the mountains are said to bear remains of oak and almond forest; no material however has come to hand from this northern vegetational zone which would appear to be the southern extremity of the Jordanian mountain forests.

The rainfall regime of this zone is mostly Mediterranean, i.e. winter rains; but in the south, around Taif, slight summer rains also fall.

3. The highlands of Asir and the Yemen by virtue of a heavier rainfall are considerably greener than those further north. The mountain-peaks over 8000 feet are clothed with juniper and the lower slopes support a great variety of aromatic and other shrubs, predominantly Ethiopian.

The rainfall regime is tropical (monsoon), i.e. summer rains.

4. The Southern Coast. At the western extremity of this coast near Aden there is fair amount of run-off from the mountains along numerous water-courses where the vegetation is considerably denser; the dominants consist of *Zizyphus*, *Salvadora persica*, *Ficus*, etc., in the wadis, and *Acacia*, *Commiphora*, and various tree *Euphorbias* on the dry intervening parts. The rainfall is about equal to that of the western coast zone (1). Eastwards the coast becomes progressively more arid.

Dhofar forms an exception; it is encircled by a crescent-shaped range of mountains which catch a fair share of the south-west monsoon. The rainfall here is probably greater than anywhere else in Arabia and the southern slopes of the mountains are thickly covered by vegetation, such as *Ficus*, and (?) *Parrotia*.

It is remarkable that the lepidoptera of this region are decidedly more Ethiopian than Indian in character. The rainfall regime is Tropical.

5. Central Arabia consists of a flat plain gently sloping from west to east; it is mainly hard sand and gravel. The perennial vegetation is sparsely thorn-scrub and salt bush scrub (e.g. *Acacia*, *Lycium*, *Indigofera*, *Salsola*, etc.) but the annuals may in a good rainy season form a continuous green carpet. The sands may either be completely bare or often support a considerable perennial growth of *Compositae* and *Chenopodiaceae* as well as various grasses; characteristic are *Rhanterium*, *Salsola*, *Haloxylon*, *Pennisetum*, *Panicum*, and *Zygophyllum*. Most sands after rain will also produce considerable annual vegetation.

The rainfall regime is Mediterranean, but scanty.

6. The Eastern coast is a vast expanse of salt flats partly covered by sand dunes. The sands near the coast carry more vegetation than those further inland, particularly those near the north end of the peninsula. The characteristic species are much the same as in Central Arabia (zone 5) with the addition of *Prosopis spicigera* in the Oman peninsula; *Acacia* becomes rarer northwards and is absent around Kuwait.

The lepidoptera of this coast are mostly Eremic, but the Tropical elements are more Indian than Ethiopian. The rainfall regime is Mediterranean, but scanty.

7. The mountains of Oman are still practically unexplored and no material was received from them. The information available indicates that they are not unlike those of the Hejaz but the flora may be nearer that of Southern Persia. Much depends on the amount if any of monsoon rains which the peaks may or may not receive.

## FAUNISTIC BOUNDARIES

Arabia as a whole presents a faunistic transition between the Temperate and Tropical Zones and also between the Ethiopian and Indian Tropical Regions. Its natural features run north and south and so tend to facilitate exchanges between the Temperate and Tropical Faunas, though the total effect is limited by the arid climate. The absence of mountains running from east to west and the extreme aridity of the centre and south-east have reduced to a minimum exchanges between Ethiopian and Indian faunas, in the recent epoch. The Western range, also, is rather low just at (1), and north of, the Tropic, and this has, in addition to the arid climate, somewhat limited exchanges between Temperate and Tropical faunas.

(<sup>1</sup>) Here, Mr. Popov's Zones 1 and 2 actually cross the Tropic (as do his Zones 5, 6 and 7 further east), but the Tropical sector of the Hejaz range (Zone 2) receives slight summer rains and would therefore seem to be transitional between Zones 2 and 3; the low elevation of the range just at and north of the Tropic had indeed inclined me to consider this

The overlapping and exchanges between Temperate and Tropical elements is greater than that between Ethiopian and Indian; and, except in Oman and the shores of the Persian Gulf, the Tropical element in Arabia is predominantly Ethiopian, as will appear from the list which follows. The Palearctic element is predominantly sub-tropical and Eremic; north-central Arabia is the headquarters of the Eastern Eremic fauna, part of which extends into Central Asia; however, the Saharan element is also fairly richly represented there, and even extends further eastwards, though becoming weaker, towards India. The question whether one should really consider the Eremic fauna as Temperate becomes a very pertinent one in studying Arabia, but cannot be discussed here; some indication of my views on this subject have been given in Part II of my "Lepidoptera of the Kingdom of Egypt" (*Bull. Soc. Fouad I<sup>er</sup> d'Entomologie*, XXXIII, 1949). A widespread Tropical-Eremic or Sudanian-Deccanian element is strong in Arabia and occurs both east and west of the subcontinent.

Owing to its transitional character, which has just been stressed, it is not easy to draw boundary lines between the natural regions in Arabia. As regards the boundary between the Temperate and the Tropical Zones, it is perhaps best to consider this to run exactly along the Tropic of Cancer, as it does by geographical definition, bearing in mind that the Eremic fauna, as a whole, probably cannot be strictly considered either Temperate or Tropical, but as transitional between the two, and inhabiting both north and south of the line. As regards the frontier between the Ethiopian and the Indo-Malayan, this is more interesting; there appear good reasons for drawing this line from a point on the south coast between Dhofar and Muscat north-westwards through the most arid parts of central Arabia towards the Mediterranean. In a few cases, which have been discussed in Part II of my "Lepidoptera of the Kingdom of Egypt" (l.c.) (e.g. *Zizeeria knysna* subsp. *karsandra* Moore) a typical Indian subspecies of a Tropical species possessing a distinct Ethiopian subspecies actually inhabits Egypt and the Eastern Mediterranean.

Despite these cases, it is better to draw the boundary-line from Central Arabia up the watershed between the Mediterranean and Euphrates basins, northwards until a point is reached so northerly and cool that it is needless to demarcate two Tropical Regions from one another any further. It should be noted, too, that the drawing of this line north of the Tropic merely indicates the general limits to which Tropical species from the two regions

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southern sector (the highlands of Taif) as belonging to the Asir; but not having actually seen the country, I have yielded to Mr. Попов, who has seen it, as to the zonal subdivision of Arabia; the exact demarcation between these Zones is probably unimportant in so transitional a tract.



in some cases reach and that they are not in a majority on this subtropical territory, but outnumbered by Palearctic species. The occurrence of a few Indo-Malayan elements (e.g. *Z. k. karsandra*) west of this line may then be considered exceptional, while the occurrence of Indo-Malayan species up to it (e.g. *Nadiasa siva* in Iraq) may be considered characteristic.

Fuller evidence for the two frontiers just suggested is mentioned under the Natural Zones briefly described above and in the list of lepidoptera below. The drawing of boundary-lines, it must also be remembered, is a rather unnatural procedure, and most attempts to do so between natural zones and regions should be regarded as generalisations, and not as absolute facts. Modern zoogeographical thought, indeed, is reacting away from demarcations and towards a more dynamic concept.

### ALPHABETICAL LIST OF LOCALITIES

Material was collected at the following localities, by the collectors whose initials are given for each; their full-names are given at the end of the locality-list. The zones, described above, in which each locality is situated, are given.

Abha, Asir Mts., 8,000 feet, vii, viii.44 (ARW); vi.48 (GP). Zone 3.

Abu Hadriya, 48.55 E., 22.27 N., ii.46 (IMcE). Zone 5.

Ahwash, Asir, 80 miles south-east of Sabya; 19.x.47 (GP). Transitional between zones 1 and 3.

Ain Ibn Fuhaid, (?) 42.18 E., 30.13 N., iii.48 (H). Zone 5.

Anaizeh, Nejd, i.46 (IMcE). Zone 5.

Artawiya, 45.35 E., 26.30 N., Dahana, ii.46 (SGG). Zone 5.

Asir, the northern sector of Zone 3. Contains many localities.

Ashaira, Tropical Hejaz, i.48 (ARW). Zone 2.

Awaniya, Dahana, i, ii.46 (IMcE). Zone 5.

Bahrain Oasis, in Wadi Fatima, Tropical Hejaz, i.48 (ARW). Zone 1.

Bajsa, coastal plain south of Kuwait 10.ii.44 (VD). Zone 6.

Balum, southern edge of Nefud, north of Buraida, 12.iv.46 (DVF). Zone 5.

Batina, coastal plain of Eastern Oman, i.44 (GP, DVF). Zone 6.

Birka, Tropical Hejaz, i.45 (BPU), i, ii.48 (ARW). Zone 2.

Bir Shari, 43.27 E., 27.14 N., iii.48 (JDF). Zone 5.

Bisha, Asir, viii.44 (ARW). Transitional between Zones 3 and 5.

Buraida, 43.59 E., 26.19 N., in Nejd, 6.i.46. Zone 5.

Buraiman, M.E.A.L.U. camp near Jedda, Tropical Hejaz, and vicinity · xi-xii.44 (ARW); i-iii.48 (ARW); i.48 (GP). Zone 1.

Buraimi, west of the Hajar Mts., Oman, 1.iii.44 (DVF); iv.48 (Th.). Zone 6.

Burqan, 30 miles south of Kuwait, 24-30.xii.43 (VD). Zone 6.

Dafina, 4.vi.46 (DVF). Zone 2.

Dahana, a long chain of sand-hills between Riyadh (capital of Nejd) and Jabrin (further east); includes such localities as Artawiya, Sayarat, etc., i-ii.46 (SGG); iii.48 (H). Zone 5.

Dhofar, includes Qara Mts., 13-16.x.43 (DVF). Zone 4.

El Khatt, Trucial Oman, 16.iv.43 (DVF). Zone 6.

Feifa, 43.05 E., 17.15 N., Asir, 1.i.47 (DVF). Zone 3.

Felij, Trucial Oman, 8.iv.43 (DVF). Zone 6.

Goz, near Qunfidha, Asir Tahama, iii.48 (BPU and ARW). Zone 1.

Hafar, 46.00 E., 28.34 N., North-east Arabia, ii.46 (IMcE). Zone 5.

Hail, Jebel Shammar, North-central Arabia, iv.44 (ARW); i.46 (SGG). Zone 5.

Hamatiyat, water-well 13, near Kuwait, 28.x.43 (VD). Zone 6.

Hanakiya, 70 miles north-east of Medina, 10.iv.44 (DVF). Zone 5.

Harat Bogum (Harrat el Buqum) Asir, 14.viii.44 (ARW); 13.ii.48 (GP). Zone 5.

Hejaz; the name applies both to the range and to the province of West Arabia, north of Jedda and Taif and south of the Jordan frontier; it is both sub-Tropical and Tropical, but the sub-Tropical has hardly been worked, except for a short visit to Medain Salih; the Tropical sector includes Ashaira, Birka, Madraqa, Wadi Fatima, Wadi Yemeniya, and other localities, q.v. Zone 2.

Hinna, ii.46 (IMcE). Zone 5.

Jabrin, oasis just south of the Tropic in East Arabia, iii.48 (H). Zone 5.

Jebel Filig, i-ii.46 (SGG). Zone 5.

Jebel Shammar, district in north-central Arabia, i.44 (ARW); ii-iii.46 (IMcE, DVF, SGG); iii.48 (H). Zone 5.

Jedda, port of Mecca, Tropical west Arabia, divides Hejaz, on the north, from Asir, on the south. Zone 1.

Khamis Mushait, Asir Mts, viii.44 (ARW). Zone 3.

Kuwait, a state on the coast of North-east Arabia, iv-v.43 (EPW); x-xii.43 and ii-iii.44 (VD); iii.46 (DVF). Zone 6.

Lina, ii.46 (IMcE). Zone 5.

Lith, near Jedda, i.45 (BPU). Zone 1.

Maagala, 47.45 E., 26.30 N., i-ii.46 (SGG and IMcE). Zone 5.

Madraqa, Tropical Hejaz, ii.48 (ARW, GP). Zone 2.

Mahdatha, near Ashaira, Tropical Hejaz, i. 48 (ARW). Zone 2.

Mahz El Tain, 40 miles south of Kuwait, 24.ii.44 (VD). Zone 6.

Mecca district, West Tropical Arabia, viii.44 (ARW). Zone 2.

Medain Salih, on Medina railway, north Hejaz, 38.15 E., 27.N., iv.46 (DVF). Zone 2.

Medina, the 2nd holy city, after Mecca, of the Hejaz, 220 miles north of Mecca, and about 70 miles north of the Tropic. Zone 2.

Mujairima, 75 miles south of Jedda, i.45 (BPU). Zone 1.

Muwaih, 23.ii.48 (GP). Zone 2.

Najran, vi.48 (GP). Zone 3.

Nefud, a region of sand-hills north of Hail, ii.46 (SGG). Zone 5.

Nejd, province of north-east Arabia, ii.46 (DVF), etc. Zone 5.

Oman, excluding Trucial Oman, is a state in south-east Arabia, includes Muscat, Shinas, Batina; i.44 (DVF). Zone 6.

Qanuna, Asir, iv.48 (GP). Zone 1.

Qara Mts., at Dhofar, 13-16.x.43 (DVF). Zone 4.

Qunfidha, Tihama of Asir, xii.45 (DVF). Zone 1.

Raniya (see Wadi Raniya).

Ras El Khaïma, Trucial Oman, i.44 (DVF). Zone 6.

Ras Safaniya, 48.45 E., 27.58 N. (IMcE). Zone 6.

Rass, 43.28 E., 25.52 N., in Nejd, iv.49 (JDF). Zone 5.

Rumaihiya, ii.46 (SGG). Zone 5.

Sabiya, Asir, iii.45 (ARW). Zone 1. (Also an unnamed locality 25 miles east of Sabyia, x.47 (GP), in Zone 3).

Sayarat, North Dahana, 44.50 E., 27.10 N. (DVF). Zone 5.

Shaqna, Nejd, iv.44 (DVF). Zone 5.

Shaq Yemeniya. Tihama of Asir, iii.48 (BPU and ARW). Zone 1.

Sharaya, i.45 (BPU). Zone 2.

Shinas, Batina. Oman, i.44 (DVF). Zone 6.

Suda, Asir Mts., 10.000 feet, vi-vii.46 (DVF); vi.48 (ARW). Zone 3.

Suda, coastal plain south of Kuwait, 2.ii.44 (VD). Zone 6.

Tahama or Tihama, i.e. coastal plain of West Arabia, has two sectors, that adjoining the Hejaz in the north, and the Asir, in the south. Includes many localities, e.g. Buraiman, Goz, etc. Zone 1.

Taif, hill-station of Mecca, up to 8.000 feet; viii.44 (ARW); iv, v.47 (DVF). Zone 2. (Also an unnamed locality 100 miles south-east of Taif situated at 41.30 E., 21.00 N., autumn 1947 (GP), probably transitional between Zones 3 and 5.

Taiz, Yemen, viii-ix.46 (ARW). Zone 3.

Thoqaif, Asir, high juniper forest (40.30 E., 20.30 N.), xii.46 (DVF). Zone 3.

Trucial Oman, a series of small states in East Arabia, on the south coast of the Persian Gulf; i.44 (DVF). Zone 6.

Usran, Asir, viii.44 (ARW). Zone 3.

Wadi Dhila, Asir, ii.45 (DVF). Zone 3.

Wadi Duka, Tihama of Asir, iv.48 (BPU and ARW). Zone 1.

Wadi El Ahsiba, 41.20 E., 19.20 N.; near Qunfidha, iii.46 (GP). Zone 1.

Wadi Fatima, Tropical Hejaz, i.48 (ARW). Zone 2.

Wadi Hijla, Asir, viii.44 (ARW). Zone 3.

Wadi Qanuna, Tihama of Asir, iv.48 (BPU and ARW). Zone 1.

Wadi Raniya, Hejaz, ii.48 (GP). Transitional between Zones 2, 3, and 5.

Wadi Sahba, Eastern Arabia, iii.48 (H). Zone 5.

Wadi Tabala, near Bisha, 9.v., 15.viii.44 (ARW). Transitional between Zones 3 and 5.

Wadi Yemeniya, Tropical Hejaz, i.48. Zone 2.

Yemen, a state in south-west Arabia, between the Asir Mts., in Saudi Arabia, and the Aden Protectorate; collected in by M.E.A.L.U. only at Taiz, q.v. Zone 3.

Yiba, Tihama of Asir, iii.48 (BPU and ARW). Zone 1.

#### NAMES OF COLLECTORS

(Those in brackets were not in the Anti-Locust Units).

(Mrs. Violet Dickson), J.D. Fawcett, S.G. Gibbons, Hewitt, I. MacEwan, G. Popov, (W. Thesiger), B.P. Uvarov, C.M.G., D.Sc., etc., D. Vesey-Fitzgerald, A.R. Waterston, (E.P. Wiltshire).

#### LIST OF NEW SPECIES AND FORMS DESCRIBED FROM THIS MATERIAL

1. In this article :

*Sterrhia illustrior*, and *Glossotrophia uvarovi*.

2. In previous articles :

(1944) "Middle East Lepidoptera, III: New forms and species", by E.P. Wiltshire (*Ent. Rec.*, LVI, Oct.).

*Chondrostega brunneicornis*, *Autophila cymaenotaenia orthotaenia*.

(1947) "Middle East Lepidoptera, VII: New species and forms from Egypt and Arabia", by E.P. Wiltshire (*Bull. Soc. Fouad, 1<sup>re</sup> Entom.*, XXXI) :

*Lambessa gibbonsi*, *Tarache hemipentha*, *Earias waterstoni*, *Clytie sabaea*, *Lithostegia fitzgeraldi*.

(1948) "The Lepidoptera of the Kingdom of Egypt", Part I, by E.P. Wiltshire, (l.c., XXXII) :

*Thalerastria alfieri*, *Thalerastria insignis rex*.

(1949) "Middle East Lepidoptera, IX : New species and forms from Arabia and Persia", by E.P. Wiltshire (l.c., XXXIII) :

*Eumenis tewfiki*, *Cucullia tropicarabica*, *Cucullia macewani*, *Catamecia minima arabica*, *Parallelia utarovi*, *Anydrophila fouadi grisea*, *Armada waterstoni*, *Proconis arabica*, *Hemidromodes robusta triforma*, *Glossotrophia buraimana*, *Cossus tahamae*, *Acanthopsyche (Dasaratha) arabica*.

(1949) "The Lepidoptera of the Kingdom of Egypt", Part II, by E.P. Wiltshire (l.c.) ;

*Sterrrha sordidior*, *Sterrrha mimetes africanarabica*.

## LIST

### Super-family : Papilionoidea

#### Family : Satyridae

##### 1. *Eumenis tewfiki* Wiltshire, 1949.

28.viii.44, 8,000 feet, Abha, Asir (ARW).

The other material mentioned in the description is all from 8,000-10,000 feet in the mountains of South West Arabia (Asir, Yemen, and Aden Protectorate).

Endemic.

##### 2. *Melanitis leda* L. *africana* Fruhst.

28.xii.46, Wadi Sabya, Asir (DVF).

This is the tropical "rice butterfly", widespread in India and Africa.

##### 3. *Ypthima asterope* Klug.

13-16.x.43, Dhofar (DVF); 1.iii.44, Buraimi, Oman (DVF); i.45, Birka (BPU); ii.45, Wadi Dhila (DVF); 31.iii.48, Wadi Qanuna (ARW and BPU); 30.iii.48, Wadi Yiba (ARW and BPU).

This is a widespread Tropical grass-feeding butterfly, penetrating the Eastern Mediterranean but conspicuously absent from Egypt and Iraq.

##### 4. *Pararge felix* Warnecke 1929.

29.vi. and 1.viii.46, 10,000 ft., Suda (DVF); 18.vi.48, Suda (GP.).

Endemic to the South-west Arabian Mountains.

#### Family : Danaidae

##### 5. *Danaus chrysippus* L.

9.iv.43, Felij, Oman, common (DVF); 13-16.x.43, Dhofar (DVF); 31.iii.48, Qanuna Khalt (BPU and ARW); ii.45, Wadi Dhila (DVF); i.45, Lith (BPU); 1.iv.48, Wadi Qanuna (BPU and ARW).



The specimen from Lith is f. *alcippus* Klug, with white hindwings.  
A widespread Tropical species of India and Africa, somewhat migratory.

#### Family : Nymphalidae

##### 6. *Junonia orithya* here Lang.

14.iv.43, El Khatt (DVF); 13-16.x.43, Dhofar (DVF); ii.45, Wadi Dhila (DVF); 15.xii.46, Sabiya, Asir (GP); 30.iii.48, Wadi Yiba, and 1.iv.48, Wadi Qanuna (BPU and ARW).

A widespread Old-world Tropical species, somewhat migratory. Inhabits Iraq and Persia but not Egypt nor the Mediterranean. The race *here* inhabits Arabia and Iraq.

##### 7. *Junonia lintingensis cebrene* Trimen.

ii.45, Wadi Dhila (DVF); 1.vii.46, 10,000 feet, Suda, Asir (DVF); 28.xii.46, Wadi Sabiya, Asir (DVF); 22.vii.44, Abha, 8000 feet, Asir (ARW).

The African race of a widespread old-world Tropical species, somewhat migratory.

##### 8. *Precis limnoria* Klug.

1.vii.46, 10,000 feet, Suda (DVF); 1.i.47, Feifa (DVF.).  
Ethiopian.

##### 9. *Precis chorimene* Guerin.

3.ix.46, Wadi Shereeya, Yemen (GP); 21.x.47, 25 miles east of Sabiya, Asir (GP.).  
Ethiopian.

##### 10. *Melitaea abyssinica* Ob. *scotti* Higg. 1941.

i.45, mountains near Mecca (BPU); 30.iv.47, granite hills, Taif (DVF).

The race was described from material in the British Museum from Yemen and the Western Aden Protectorate, and is better known now than the typical race which inhabits Abyssinia. The other Old-world species of this genus are Palearctic.

##### 11. *Byblia acheloia* Walleng.

2.vii.46, 7500 feet, Asir (DVF); 21.x.47, 25 miles east of Sabiya; 19.x.47, Ahwash, Asir (GP).

##### 12. *Byblia ilithya* Drury.

13-16.x.43, Dhofar (DVF).  
Ethiopian.

##### 13. *Acreea encedon* L. *subsp.*

1.i.47, Feifa (DVF).

The name *rathjensi* Ledoux is the one proposed for the Arabian race

of this Tropical African butterfly, but I do not know whether it has been published.

**14. *Acraea doubledayi* Guerin subsp. *arabica* Eltr.**

21.x.47, 25 miles East of Sabiya, Asir (GP).

Nota-bene : Other *Acraea* species known also from South-west Arabia but not taken by M.E.A.L.U. are : 14 a. *Acraea violae* F. subsp. *arabica* Rebel, and 14 b. *Acraea chilo* Godm. subsp. *yemenensis* Ledoux.

**15. *Vanessa cardui* L.**

18.xi.44, 19.i.48, Buraiman Camp (ARW).

It is surprising that more specimens were not taken of this 'Tropical-Subtropical migrant

**16. *Charaxes varanes bertrami* Riley.**

13-16.x.43, Dhofar (DVF).

The endemic race of an Ethiopian species.

**Family : Lycaenidae**

**Sub-family : Theclinae**

**17. *Myrina silenus* F.**

13-16.x.43, Dhofar (DVF); 11.xii.46, Thoqaif, heights with juniper forest (DVF).

Ethiopian.

**18. *Deudorix antalus* Hopf.**

1.i.47, Feifa (DVF); 30.vi.46, 10,000 feet, Suda, Asir (DVF).

Ethiopian.

**19. *Anthene amarah* (Guerin).**

ii.45, Wadi Dhila, Asir (DVF); 13-16.x.43, Dhofar (DVF); 30.vi.46, 10,000 feet, Suda, Asir (DVF); 1.i.47, Feifa (DVF); 16.i.48, common on *Cadaba* flowers, Buraiman (ARW).

A Tropical-Eremic butterfly feeding on *Acacia* widespread in Africa. where it reaches the extreme South but not the North coast.

**Sub-family : Aphnaeinae**

**20. *Apharitis acamas bellatrix* Butler.**

One unlabelled specimen in the M.E.A.L.U. material, probably from Asir, whence the British Museum already has one, ex coll. Klug.

A Pan-Eremic species.

**Sub-family : Lycaeninae**

**21. *Lycaena phloea* subsp. *pseudophloea* Lucas.**

29.vi.46, 10,000 feet, Asir (DVF); 11.xii.46, Thoqaif heights (DVF); 1.i.47, Feifa (DVF); 15.vi.48, Abha, Asir (GP).

The Arabian race is perhaps slightly different from the race of the high East African mountains, but certainly comes closer to that than to any of the Palearctic forms.

A Euro-Siberian species, only occurring at great heights subject to heavy rain in the Tropics.

Sub-family : *Lampidinae*

22. *Gosmolyce baeticus* L.

29.i.48, Bahrain oasis, Hejaz (ARW).

A widespread Tropical and Subtropical migrant, of which surprisingly few have been taken.

23. *Gacyreus virilis* Auriv.

30.vi.46, 10,000 feet, Suda (DVF).

One of a group of four very similar widespread Tropical African butterflies distinguishable by genitalia from one another.

24. *Syntarucus telicanus* Lang.

30.iii.48, Wadi Yiba, and 31.iii.48, Qanuna Khalt (BPU and ARW).

A widespread Old World Tropical and Subtropical species.

25. *Euchrysops osiris* Hopf.

13-16.x.43, apparently common, Dhofar (DVF).

Ethiopian.

26. *Tarucus mediterraneae* B.-Baker.

31.iii.48, Qanuna Khalt and 1.iv.48, Wadi Duka (BPU and ARW);

29.i.48, Bahrain oasis, Hejaz (ARW); 22.i.48, Birka (ARW).

An Eremic member of a group of four similar butterflies, feeding on on Rhamnaceae, distinguishable from one another by genitalia; the group ranges from North-west Africa to North-west India, and inhabits the Mediterranean and South-west Asia, but this is the only species of it so far discovered and positively identified by structural characters in Arabia.

A ♀ from Dhofar (DVF) could not be identified.

Sub-family : *Everinae*

27. *Azanus ubaldus* Gr.

ii.45, Wadi Dhila, Asir (DVF); 13.viii.44, Wadi Yemeniya, Mecca district, on *Acacia* (ARW); 4.iv.48, Wadi Duka (BPU and ARW).

Ethiopian.

28. *Azanus jesous* Guerin.

13-16.x.43, Dhofar (DVF); ii.45, Wadi Dhila, Asir (DVF); 13.viii.44, Wadi Yemeniya, Mecca district, on *Acacia* (ARW); 16.i.48, to *Cadaba* flowers, Buraiman (ARW).

An Ethiopian or Tropical-Eremic species, penetrating further north than the preceding, i.e. to the Eastern Mediterranean; both feed on *Acacia*.

Sub-family : Plebeinae (=Polyommatae).

**29. *Chilades galba* Led. subsp.**

8.iv.43, Felij (DVF).

A large race, of an Eastern Eremic species.

**30. *Freyeria trochylus* (Freyer).**

13-16.x.43, Dhofar (DVF); 14.v.44, Hail, Jebel Shammar (ARW); 1.ii.48, Birka (ARW); 30.iii.48, Goz (BPU and ARW).

A Paleo-Tropical species penetrating the East Mediterranean.

**31. *Polyommatus loewii* Z.**

12.iv.46, Balum (DVF).

Pan-Eremic, feeding on *Astragalus*.

Sub-family : Zizeerinae

**32. *Zizeeria knysna knysna* Trimen.**

13-16.x.43, Dhofar (DVF); 30.vi.46, 10,000 feet, Suda, Asir (DVF); 27.i.48, Birka, and 30.iii.48, Wadi Yiba, and 31.iii.48, Qanuna, and 4.iv.48, Wadi Duka (BPU and ARW).

The South-African form of a widespread Paleo-Tropical butterfly.

**Family : Pieridae**

**33. *Eronia buqueti* Boisd. arabica Hopf.**

13-16.x.43, Dhofar (DVF); ii.45, Wadi Dhila, Asir (DVF).

Ethiopian.

**34. *Leucochloe glauconome* Klug.**

ii.45, Wadi Dhila (DVF); 15.xii.44, Sabiya (GP); 17.i.48, to flowers of *Farsetia* Buraiman (ARW); 6 and 26.iii.48, Buraiman (GP).

A Pan-Eremic butterfly.

**35. *Leucochloe daplidice* L.**

4.v.47, in copula, Thoqaif heights, 8,000 feet (DVF).

A Palearctic migrant permanently inhabiting the high mountains of S.-W. Arabia and E. Africa.

**36. *Glycestha aurota* F. (= *mesentina* auctt.).**

8.iv.43, common, Felij (DVF); 4.vi.46, Dafina (DVF); xii.45 and 1.iii.46, Wadi el Ahsiba, near Qunfidha (DVF and GP); 28.iii.48, Buraiman (BPU and ARW); 30.iii.48, Goz, and 3.iv.48, Qanuna (BPU and ARW).

A Paleo-Tropical butterfly migrating often into Sub-Tropical parts of the Palearctic region.

**37. *Euchloe helemia* Esp.**

3.iii.46, Jebel Shammar.

A widespread Mediterranean steppe butterfly.

**38. *Anthocharis charlonia* Donz.**

1.ii.46, Great Nefud, and 2.iii.46, Jebel Shammar (SGG).

Pan-Eremic.

**39. *Colotis calais* Stoll subsp. *amatus* P.**

13-16.x.43, Dhofar (DVF); ii.45, Wadi Dhila (DVF); 31.iii.48, Wadi Qanuna and 30.iii.48, Wadi Yiba, both Asir Tahama (BPU and ARW).

The Asian form of an Old World Tropical species.

**40. *Colotis phisadia* Godart.**

ii.45, Wadi Dhila, Asir (DVF); 2.xi.46, Sabya, Asir (DVF); 5.xii.46, swarming over *Salvadora persica*, Sabya (GP).

Ranges from N.-W. India through Africa to Madagascar and N.-W. Africa.

**41. *Colotis chrysonome* Klug.**

13-16.x.43, Dhofar (DVF); ii.45, Wadi Dhila, Asir (DVF); ii.48, Ashaira (ARW); 31.i.48, Mahdatha (ARW); 31.iii.48, Qanuna Khalt and 30.iii.48, Wadi Yiba (BPU and ARW).

A Tropical African and Arabian butterfly, not penetrating far south.

**42. *Colotis eris* Klug.**

13-16.x.43, Dhofar (DVF).

Sudanian.

**43. *Colotis protomedia* Klug.**

26.i.48, Shatek esh Shami near Qunfidha (GP).

Range similar to that of *G. chrysonome* (above).

**44. *Colotis halimede* Klug subsp. *caelestis* Swinh.**

3.xii.44, Buraiman (ARW); 16.i.48, on flowers of *Cadaba glandulosa*, Buraiman (ARW).

Paleo-Tropical.

**45. *Colotis pleione* Klug.**

3.xii.44, Buraiman (ARW); 16.i.48, on flowers of *Cadaba glandulosa*, Buraiman (ARW).

A Tropical West African and Arabian species.

**46. *Colotis दौरα* Klug.**

ii.45, Wadi Dhila, Asir (DVF).

A Tropical African and Arabian butterfly.



**47. *Colotis ephyia* Klug.**

31.iii.48, Qanuna Khalt (BPU and ARW).

Hitherto only known from the Sudan.

**48. *Colotis liagore* Klug.**

ii.45, Wadi Dhila, Asir (DVF) ; 15.ii.48, a pair in copula, Harat Boguun (GP) ; 15.viii.44, Wadi near Mecca (ARW).

Tropical Sahara and Baluchistan.

**49. *Colotis antigone* (Boisd.) ssp. *evagore* Klug.**

30.iii.48, Wadi Yiba, and 31.iii.49, Qanuna Khalt, and 4.iv.48, Wadi Duka (BPU and ARW) ; 22.i.48, Birka (ARW).

A Tropical African and Arabian species which penetrates North-west Africa.

**50. *Colotis eulimene* (Klug).**

16.i.48, at *Cadaba* flowers, Buraiman (ARW) ; 28.iii.48, Shaq Yemeniya, Asir Tahama (ARW).

Also known from the Red Sea coast of the Sudan.

**51. *Colotis fausta* Oliv.**

8.xi.43, Kuwait (VD).

**52. *Pinacopteryx eriphia* Godart.**

13-16.x.43, Dhofar.

Tropical African.

**53. *Colias electo* L. subsp. *electo* L.**

16.i.48, Suda (GP).

This species (*croceus* Fourc.) is best known as a Palearctic migrant ; the South-west Arabian forms, which only occur at great heights, apparently belong to the race of the East African peaks. The distinctness of the Tropical highland race is proof that it no longer migrates from zone to zone.

**54. *Catopsilia florella* F.**

1.iii.46, Wadi el Ahsiba (GP) ; 31.iii.48, around *Zizyphus*, Qanuna Khalt, and 3.iv.48, Wadi Duka (BPU and ARW).

A Tropical migrant, feeding on *Cassia* ; principally African, also Ceylon.

**55. *Eurema hecabe* L. *senegalensis* B.**

ii.45, Wadi Dhila (DVF) ; 1.iv.48, Wadi Qanuna (BPU and ARW).

Paleo-Tropical.

**Family : Papilionidae**

**56. *Papilio demoleus* L.**

8.iv.43, in gardens, Felij (DVF).

(See Wiltshire (1945) "Studies in the geography of Lepidoptera

II : Swallow-tails in desertic S.-W. Asia" (*Proc. R. Ent. Soc. London*, A, 20.i.30, and Corbet (1948) "Observations on the species of *Rhopalocera* common to Madagascar and the Oriental Region" (*Trans. R. Ent. Soc. London* 99, Pt. 17), regarding the zoogeography of this species and its Ethiopian vicariant *demodocus* Esp.).

. A Tropical Asiatic species, dependent on *Citrus*.

**57. *Papilio demodocus* Esp.**

i.48, South-west Arabia (GP). A large but ragged example.  
Tropical African.

57a. Nota-bene : *Papilio machaon* ssp. *rathjensi* Warnecke, the Yemen race of the Holarctic species, was not taken by M.E.A.L.U. units.

**Super-Family : Hesperioidea**

**58. *Sarangesa phidyle* Moore.**

13-16.x.43, Dhofar (DVF).  
Tropical African.

**59. *Powellia galba* F.**

13-16.x.43, Dhofar (DVF).  
One male with apparently freak genitalia (Prep. 414).  
Tropical Indian.

**60. *Pelopidas thrax* Led.**

1.iv.48, Wadi Qanuna (BPU and ARW).  
In the absence of a male this identification is presumptive. The other possibility is *mathias* F. which however probably does not occur in Arabia.  
*P. thrax* is Tropical African and Sub-Tropical South-west Asian, also penetrating Egypt.

**61. *Gegenes nostradamus* F.**

2.xi.46, Sabya, Asir (DVF) ; 4.iv.48, Wadi Duka (BPU and ARW).  
A Euroriental species penetrating Abyssinia, Tropical Arabia and India.

**62. *Coeliades anchises* Gerst. f. *transitoria* ad subsp. *jucunda* Btlr.**

13-16.x.43, Dhofar (DVF). One example, between the African and Socotran forms.  
Tropical African.

**Super-family : Bombysoidea**

**Family : Lasiocampidae**

**63. *Chondrostega* (?) *aurivillii* Pung. subsp. *feisali* Wilts.**

28.x.43, Hamatiyat, Kuwait (VD).  
This is the Iraqi race.

A purer white form of this species inhabits hotter and more arid parts of Arabia, but was not taken by M.E.A.L.U. There is a series of this white form in the British Museum, leg. H. St. J. Philby.

The moth is Eastern Eremic, ranging from Palestine to Arabia and South-west Persia, unless, as is possible, the Palestinian *aurivillii* is specifically distinct.

**64. *Chondrostega brunneicornis* Wils. 1944.**

28.x.43, Hamatiyat, Kuwait (VD).

Endemic Arabian or Eastern Eremic.

**65. *Anadiasa griseata* Warren and Roths.**

19.i.48, Buraiman (ARW).

A species, hitherto known only from Sudan, belonging to an Ethiopian genus attached to *Acacia*.

**66. *Lambessa gibbonsi* Wils. 1947.**

30.i.46, Hail (SGG). Also another male, chipped, bred on 19.ii.46 from a pupa found in dead wood at Raniya (GP).

Endemic Arabian or Eastern Eremic.

**67. *Nadiasa (Taragama) sp. near das* Hering.**

7.viii.46, Taiz, Yemen (ARW).

There is a series of paler ♀♀ in the British Museum from Taif (leg. Philby).

**Family : Sphingidae**

**Sub-family : Acherontiinae**

**68. *Acherontia atropos* L.**

13-16.x.43, Dhofar (DVF).

A Tropical African and European species, probably here at its eastern limit: in Iraq the Indian species *styx* is found.

**69. *Herse convolvuli* L.**

27.iii.48, north of Lith (GP).

A Tropical and Sub-Tropical migrant.

**Sub-family : Philampelinae**

**70. *Sphinganaepiopsis nana* Boisd.**

7.iv.48, Qanuna (GP).

Tropical African.

**Sub-family : Chaerocampinae**

**71. *Hippotion rebeli* R. and J.**

10.ii.45, Sabya, Asir (DVF); 10.xii.46, Sabiya (GP).

Apparently endemic South-west Arabian.

**72. *Celerio lineata livornica* Esp.**

9.iv.43, common, Felij (DVF); xi-xii.44, Buraiman (ARW); 10.ii.46, Dahana (SGG); 8.ii.46, Maagala (IMcE); 28.ii.48, Buraiman (ARW); 13.iv.48, Qanuna (BPU and ARW); 26.iii.48, Ain ibn Fuhaid, Nejd (H); 6.v.48, Rass, Nejd (JDF); iv.48, Buraimi, Oman (T).

A Tropical and Sub-Tropical migrant of both Old and New World.

72a. Nota-bene: *Celerio euphorbiae* L. subsp. was not taken by M.E.A.L.U. but inhabits the Yemen; I have seen a series bred by Mohamed Tewfik in coll. Faculty of Science, University Fouad I, Abbasiya, Cairo.

Euroriental.

**Super-family : Agrotoidea**

**Family : Agaristidae**

**73. *Aegocera rectilinea* Hamps.**

12.ii.45, Sabiya, Asir (ARW).

Paleo-Tropical

**74. *Aegocera brevivitta* Hamps.**

ii.45, Wadi Dhila (DVF).

Paleo-Tropical.

**Family : Agrotidae (Phalaenidae)**

Subfamily : Agrotinae

**75. *Euxoa canariensis* Rebel subsp. *diamondi* Boursin.**

26.ii.48, Madraqa, Hejaz (GP).

A vernal Eremic moth.

**76. *Euxoa conspicua* Hubn.**

16.v.44, Hail, (DVF).

Euroriental.

**77. *Agrotis herzogi* Rebel (= *saracenica* Tams.).**

16, 17.xi.43, Kuwait (VD); 1.ii.46, Dahana (SGG); 19.ii.46, Awania (IMcE); 16.ii.46, Rumaihiya, Nejd (DVF); 9.ii.46, Rumaihiya (SGG); 17.ii.46, Artwaiya (DVF); 6.i.46, Buraida (IMcE).

Eremic.

**78. *Agrotis sardzeana* Brandt.**

17.xi.43, Kuwait (VD).

Eremic.

**79. *Agrotis spinifera* Hubn.**

24.i.48, Birka, Hejaz (ARW); 24.ii.48, Madraqa, Heja (GP).

Paleo-Tropical, penetrating Sub-tropics.

**80. *Agrotis segetum* Schiff.**

19.ii.46, Awania (IMcE); 21.iv.44, Shaqna, Nejd (DVF); 30.i.48, Ashai-ra, Hejaz (ARW); 5.iv.48, Qanuna (GP).

Euro-Siberian and Asiatic-Tropical; a migratory pest.

(Surprisingly *Agrotis ypsilon* L., widespread migrant and pest, was not taken by M.E.A.L.U.).

**81. *Agrotis* (subg. *Powellinia*) *lasserre* Ob.**

16.xi.43, Kuwait (VD).

Pan-Eremic.

**82. *Agrotis* (subg. *Powellinia*) *pictifascia* Hamps.**

xi-xii.44, Buraiman (ARW); i.45, Mujairima (BPU); 7.iii.45, Sabiya, Asir (ARW); i-ii.48, Buraiman (ARW); 29.i.48, Wadi Yemeniya (ARW).

A Red Sea Tropical littoral (i.e. Eremic) species.

**83. *Agrotis* (subg. *Powellinia*) *matritensis messaouda* Ob. (= *pieretti* Bugn.).**

16.xi.43, Kuwait (VD).

Eremic.

**84. *Ochropleura* (subg. *Dichagyris*) *imperator* B.-H.**

24.iv.46, Medain Saleh, Hejaz (DVF).

The first capture in Arabia of this handsome N.-African Eremic moth.

Sub-family : Hadeninae

**85. *Scotogramma trifolii* Rott.**

30.iv-2.v.43, Kuwait (EPW).

Holarctic and Paleo-Tropical.

**86. *Cardepija albipicta* Freyer.**

30.iv-2.v.43, Kuwait, very common (EPW); 23.x.-17.xi.43, Kuwait (VD); 12.iii.44, Kuwait (VD); 23.ii.46, Ras Safaniya (IMcE).

Pan-Eremic.

**87. *Pronotestera silenides* Stgr.**

24.ii.44, Mahz el Tain (VID); 20.ii.46, Hinna (IMcE).

Eremic, from N.-Africa to S.-Persia.

**88. *Hadula pulverata* B.-H.**

24.ii.44, Mahz el Tain (VD).

New to Asia; Saharan Eremic.

**89. *Hyphilare loreyi* Dup.**

22.xi.44, Buraiman (ARW).

Tropical migratory.

**90. *Polytela cliens* Felder. (= *orientalis* Hamps.).**

Larvæ : "white, with a few black marks, pupated in sand"; common



in Qunfidha area xii.45-iii.46, during mass breeding of *Celerio lineata livornica*. Larvae found 21.00 N., 41.30 E., 100 miles south-east of Taif, hatched in Jeddah 5.iii.48 (GP).

I have not yet ascertained whether Hampson's name applies to this form, which of the two names is prior, and whether both can be retained to denote races, of this moth which is known also from Subtropical North-west Sahara (Upper Dra valley) and South Persia.

**91. *Trichoclea avempacei* Tams. (= *Calophasia pampaninii* Kruger).**

20.ii.46, Hinna and Abu Hadriya (IMcE).

Eremic, from North-west Africa to Arabia and Iraq.

Subfamily : *Cuculliinae*

**92. *Pseudocopicucullia syrtana* Mab.**

24-25.xii.43, 30-31.xii.43, Burgan (VD); 24.ii.44, Mahz el Tain (VI); 8.ii.46, Maagala (IMcE); 8.i.46, Anaizeh (IMcE).

Eremic, from North Africa to South Persia.

**93. *Brachygalea albolineata* Blach.**

24.ii.44, Mahz el Tain (VD); 20.ii.46, Dahana (SGG); 22.ii.46, Sayarat (DVF).

Eremic, North-west Africa to South-west Asia.

**94. *Cucullia boryphora* F. de Wald.**

Lina, 3.ii.46 (IMcE).

Eremic.

**95. *Cuculia macewani* Wilts. 1949 (incl. f. *albidior* Wilts. 1949).**

18-23.ii.46, Dahana, Artawiya and Sayarat (IMcE and DVF).

Endemic Eremic, belonging to the *C. verbasci* group.

**96. *Cuculia tropicarabica* Wilts. 1949.**

29.i.48, Wadi Yemeniya, Tropical Hejaz (ARW).

Endemic Eremic, belonging to the *C. verbasci* group and the first example of this group to be found south of the Tropic.

**97. *Metopoceras eutychna* Rebel, 1948.**

29.i.48, Ashaira (ARW).

Known also from Sinai; Red-Sea Eremic.

**98. *Metopoceras delicata* Stgr.**

30.iv-2.v.43, Kuwait (EPW); 24.ii.44, Mahz el Tain (VD); 10.iii.44, Kuwait (VD); 18.ii.46, Artawiya, Nejd (DVF); 23.ii.46, Sayarat (DVF); 19.ii.46, Dahana (SGG).

Eastern Eremic.

**99. *Metopoceras omar* Ob.**

30.iv.-2.v.43, very common, Kuwait (EPW); 29.ii.44, Mahz el Tain (VD); 10.iii.44, numerous, Kuwait (VD); ii-iii.46, Nejd and Jebel Shammar (SGG and DVF); 25.iii.48, Hail, Jebel Shammar (JDF).

Eremic, from North Africa to South Persia.

**100. *Cleophana chabordis* Ob.**

30.iv.-2.v.43, Kuwait (EPW); 10.iii.44, Kuwait (VD); 3.iii.46, Jebel Shammar (SGG); ii.46, Dahana (DVF); 24.iii.49, Bir Shari (DVF).

Eremic, from North Africa to South Persia.

**101. *Cleophana jubata* Ob.**

3.ii.46, Lina (IMcE).

Eremic, North Africa to Iraq.

Subfamily: Zenobiinae (=Caradrininae)

**102. *Autophila cerealis* Stgr.**

i-ii-iii.46, Kuwait, Hail, Dahana (SGG., IMcE, DVF.).

An Eastern Eremic species, ranging from Sinai to Central Asia; it is rare in the Eastern desert of Egypt and does not occur west of the Nile. Its larva has been found on a desert *Salvia* in the Iraqi desert.

**103. *Autophila cymaenotaenia* Boursin *orthotaenia* Wilts.**

28.x.43, Hamatiyat, near Kuwait (VD); 24, 25.xii.43, Burqan, near Kuwait (VD); 30.i.46, Hail (SGG); 3.ii.46, Maagala (IMcE).

The Eastern race of an Eremic species ranging from North Africa to Iraq.

**104. *Tathorhynchus exsiccatus* Led.**

10.iii.44, Kuwait (VD); 19.ii.46, Awaniya (IMcE).

Widespread Tropical.

**105. *Catamecia minima* Swinhoe.**

The typical form and f. *jordana* Stgr., occurring together with transitional forms, were taken at: 30.iv.-2.v.43, Kuwait (EPW). The blackish form, *arabica* Wilts. 1949, 28.iii.48, Shaq Yemeniya (BPU and ARW).

Saharan-Sindian.

**106. *Catamecia deceptrix* Stgr.**

Not taken in Arabia by the M.E.A.L.U. but the British Museum has a series (leg. Philby) 28.xi.31, Arma, Dahana, and 13.xi.34, Khufaiiya.

An Eremic casis moth, dependent on *Lycium*, ranging from Eastern Egypt (very rare) to Iraq.

**107. *Scythocentropus inquinata* Mab.**

23.x.43, Kuwait (VD); 28.x.43, Hamatiyat, near Kuwait (VD).

Eremic, from North Africa to Iraq.

**108. *Condica connivens* Felder.**

10.iii.45, Sabiya (ARW).

Tropical.

**109. *Hadjina viscosa* Freyer subsp. *persicola* Strand.**

22.i.44, Shinas Batina, Oman (DVF).

A widespread Mediterranean moth ranging from the Canaries to South Persia, confined to oases in desert tracts, but more euryoecous in the Mediterranean basin. In the former it feeds on *Pluchea dioscorides*, in the latter on *Inula viscosa*. Probably of Tropical origin; indeed, I suspect it still inhabits parts of Tropical or South Africa, for a species with apparently identical genitalia is figured from South Africa by Janse "Moths of South Africa", Vol. III, p. 79, but is there given a different name: *Perigea capensis* Guen. The foodplant in Eremic oases, mentioned above, is a typical Ethiopian plant.

**110 and 111.**

Two still unidentified Zenobiine moths can be mentioned here: one, of which the abdomen is missing, 22.i.44, Shinas (DVF); the other, 5 and 10.iii.45, Sabiya (ARW).

**112. *Prodenia litura* F.**

26.x.43, Kuwait (VD); 24.ii.44, Mahz el Tain (VD); 22.i.44, Shinas (DVF); 29.viii.44, Khamis Mushait, Asir (ARW).

A widespread Tropical-Subtropical pest probably migratory.

**113. *Spodoptera mauritia* Bois.**

26.viii.44, Ussan, Asir (ARW); 17.viii.44, Bisha, Asir (ARW); 22.viii.44, Wadi Hijla (ARW); 29.viii.44, Khamis Mushait (ARW); 28.viii.44, Asir mountains at 8500 feet (ARW).

Tropical.

**114. *Laphygma exigua* Hubn.**

26.x.43, Kuwait (VD); 10.ii.44, Balsa (VD); 24.ii.44, Mahz el Tain (VD); 18.ii.46, Artawiya (DVF); 22.i.44, Shinas (DVF); 29.i.48, Wadi Yemeniya (ARW); 16.i.48, Buraiman (ARW); 7.xii.44 and 19.i.48, Buraiman (ARW).

A widespread Tropical and Subtropical migrant and pest.

**115. *Caradrina* (subg. *Hymenodrina*) *oberthuri* subsp. *persica* Boursin.**

10.xii.44, Buraiman (ARW).

The Eastern race of an Eremic species ranging from North Africa to South Persia.

**116. *Caradrina* (subg. *Paradrina*) *flava* Ob.**

30.i.48, Ashaira, Tropical Hejaz (ARW).

Quite common in ii in the Dahana, Nejd (IMcE., DVF., SGG).  
Eremic, Morocco to South Persia.

**117. *Rhabinopteryx subtilis* Mab.**

24.ii.44, Mahz el Tain (VD).

Very common in ii, iii in the Dahana, Nejd and also Jebel Shammar (IMcE, DVF, SGG).

Eremic, North Africa to South Persia.

**118. *Sesamia cretica* Led.**

26.ii.48, Madraqa (GP); 30.iii.48, Yiba (BPU and ARW); 19.i.48 and 18.xi.44, Buraiman (ARW); 11.ii.48, Lith (GP); 29.iii.48, Goz (BPU and ARW).

Half of the specimens, both sexes, are the dwarf form *gracilis* Rebel.

Tropical-Subtropical (? Eremic). Sometimes a pest boring cereals. Also mines stems of reeds and grasses, e.g. *Saccharum aegyptiacum*.

Subfamily : Melicleptriinae

**119. *Chloridea peltigera* Schiff.**

28.x.43, Kuwait (VD); 24.xii.43, Burqan (VD); 20.iv.44, Jebel Jelf near Hail, to light at midnight (ARW); 28.viii.44, Abha, 8000 feet, Asir (ARW); 20.iv.48, Rass (JDF).

A Mediterranean migrant ranging eastwards to Persia and southwards across the Tropic on both sides of the Red Sea.

**120. *Chloridea nubigera* H.-S.**

15.ii.48, Wadi Raniya (GP).

Similar in range to the preceding, also a migrant.

**121. *Timora albida* Hamps.**

27.iii.48, Tihama of Asir (BPU and ARW).

Eremic, North Africa to South Persia.

**122. *Timora philbyi* Brandt.**

2.ii.48, Buraiman (ARW); 27.ii.48, Madraqa (ARW).

Eastern Eremic, from Arabia to South Persia

**123. *Timora decorata* Moore.**

i.45, Mujairima (BPU).

Indian Tropical.

Subfamily : Erastrianae

**124. *Erastria melacheila* Stgr.**

10.xii.44, Buraiman (ARW).

Hitherto known only from Palestine; Red Sea Eremic

**125. *Ozarba sancta* Stgr.**

22.viii.44, Abha, 8000 ft., Asir (ARW); i.45, Mujairima (BPU); 21.ii.46,

Dahana (SGG); 10.xii.44, Buraiman (ARW); 23.viii.44, Khamis Mushait, Asir (ARW); 3.iv.48, Qanuna, and 29.iii.48, Goz (BPU and ARW); 26.ii.48, Madraqa (GP).

Eastern Eremic, from Palestine and West Arabia to South Persia; the genus is principally Ethiopian.

**126. *Eublemma admota* Feld.**

13-16.x.43, Dhofar (DVF).

Tropical.

**127. *Porphyrinia parva* Hußn.**

26.ii.48, Madraqa (ARW).

A very widespread species.

**128. *Xanthoptera mesozona* Hamps. (= *Eulocastra mediana* Stgr.).**

28.x.43, Hamatīyat, near Kuwait (VD); xii.44, very common, Buraiman (ARW).

Eremic, from North Africa to South Persia.

**129. *Thalerastria diaphora* Stgr.**

xii.44, Buraiman (ARW).

Eremic, North Africa to South Persia.

**130. *Thalerastria alfierii erythra* Wilts. 1948.**

xii.44, Buraiman (ARW).

Red Sea, Eremic; the typical form from Sinai has a whitish forewing ground-colour; this is reddish, and smaller.

**131. *Thalerastria insignis* Butl.**

28.viii.44, Khamis Mushait, Asir (ARW).

The type of ab. *rex* Wilts. 1948. Typical specimens were described from Aden.

Red Sea Eremic. The species is a close relative of *Eulocastra tamsina* Brandt (nec *tamsi* Berio).

**132. *Tarache lucida* Hufn.**

2.i.44, Shinas (DVF).

Mediterranean-Tropical.

**133. *Tarache biskrensis* Ob. *orientalis* Brandt.**

30.iv.-2.v.43, very common, Kuwait (EPW); 10.iii.43, Kuwait (VD); 31.iii.48, Jabrin oasis; 22.iii.48, Wadi Sahba, Nejd, and 25.iii.48, Hail (H); iv.48, Buraimi, Oman (T).

Eremic, North Africa to South Persia: the Eastern race.

**134. *Tarache opalinoides* Guen.**

3.iv.48, Qanuna (BPU and ARW).

Paleo-Tropical.



**135. *Tarache hemipentha* Wilt. 1947.**

18.xi.44. Buraiman (ARW).

Red Sea Eremic.

195a. Nota-bene : *Tarache hortensis* Swin. described from Karachi was taken by ARW in Eritrea and also inhabits Tropical Arabia, though not taken by M.E.A.L.U.

**136. *Tarache dichroa* Hamps.**

29.i.48, Wadi Yemeniya (ARW).

**137. *Hoplotarache* (?) *nubila* Hamps.**

29.i.48, Wadi Yemeniya (ARW). One ♀ only.

Sub-family : Eutelianae

137a. *Eutelia discistriga* Hamps. was taken by ARW in the Basso Piano of Eritrea (equivalent to the Tihama of Asir) but was not taken in Arabia by M.E.A.L.U.; it is however said to swarm and migrate in the Red Sea area, and will probably be taken in Arabia.

Sub-family : Sarrothripinae

**138. *Selepa docilis* Butler**

10.xii.44, Buraiman (ARW); 26.viii.44, Usran and 22.viii.44, Abha, 8000 feet, Asir (ARW).

Sub-family : Acontiinae

**139. *Earias waterstoni* Wilt. 1947.**

8.xii.44, Buraiman (ARW).

? Endemic Eremic.

Sub-family : Phytometrinae

**140. *Syngrapha circumflexa* L.**

8.ii.46, Maagala (IMcE).

Euroriental; probably migratory.

**141. *Phytometra gamma* L.**

1.ii.46, Nefud (SGG).

A Euro-Siberian migrant, entering the desert zone in winter.

**142. *Phytometra ni* Hubn.**

30.iv.-2.v.43, Kuwait (EPW); 26.x.43, Kuwait (VD); 24.ii.44, Mahz el Tain (VD); 30.iii.48, Yiba (BPU and ARW).

A migrant and pest of Palearctic ranging, also crossing the Tropic in the Red Sea area.

## Sub-family : Catocalinae

**143. *Hypotacha ochribasalis* Hamps.**

17.iii.44, Bisha, Asir (ARW); 17.i.44, Hail (ARW); i.48, Buraiman (ARW); 30.i.48, Ashaira (ARW); 29.i.48, Wadi Yemeniya (ARW).

Red Sea Eremic, perhaps ranging wider.

**144. *Hypotacha raffaldii* Berio**

29.i.48, Wadi Yemeniya (ARW).

Also known from Eritrea.

**145. Gen.? spec.?**

29.i.48, Ashaira, Hejaz.

**146. *Mocis frugalis* F.**

29.i.48, Bahrain oasis and Wadi Yemeniya (ARW); 5.xi.44, Ras el Khaima, Trucial Oman (DVF); 30.iii.48, Wadi Yiba (BPU and ARW).

Paleotropical.

**147. *Calpe nubifera* Hamps.**

i.45, 18 miles east of Mecca (BPU).

Eremic.

**148. *Achaea catella* Guenée**

7.iii.45, Sabya, Asir (ARW); 29.i.48, Wadi Yemeneiya (ARW).

A Tropical migrant.

**149. *Sphingomorpha chlorea* Gr.**

19.ix.44, Buraiman (ARW); 6.v.48, Rass (JDF).

A Tropical migrant.

**150. *Ericeia inangulata* Guenée.**

10.iii.45, Sabya, Asir (ARW).

A widespread Tropical species.

**151. *Parallelia uvarovi* Wilts. (1949).**

1.iii.48, Madraqa (ARW); 29.i.48, Wadi Yemeniya (ARW).

Red Sea Eremic.

**152. *Ophiusa albivitta* Moore.**

13-16.x.43, Dhofar (DVF).

Paleo-Tropical, penetrating the Subtropics.

**153. *Hypoglaucitis benenotata* Warren.**

30.iii.48, Yiba and 5.iv.48, Qanuna (BPU and ARW).

Saharan-Sindian, on *Tamarix*.

**154. *Clytie sabaea* Wilts. 1947.**

This name may be a synonym of *scotorhiza* Pung.; at least, specimens of the species in the British Museum from Arabia are identified as *scotorhiza*.

*C. scotorrhiza* is only known from a description from Palestine, with which these examples do not agree. Pungeler's type is in Berlin, inaccessible to me. Its genitalia should be compared with the figure given in my 1947 description of *sabaea*.

30.iii.48, Yiba (BPU and ARW); 7.iii.45, Sabya (ARW).

A specimen was also taken by ARW in Eritrea at Maaba on 10.i.48, and it occurs rarely in the Eastern desert of Egypt.

The foodplant is doubtless *Tamarix*. The species is clearly a Red Sea Eremic one.

**155. *Scodionyx mysticus* Stgr.**

22.viii.44, Wadi Hijla, Asir (ARW).

Eremic, from Palestine and Arabia to Morocco; on *Acacia*.

**156. *Cortyta impar* Hampson f. *fasciolata* Warren.**

The male tibia is spineless, yet Hampson put this genus in the *Catocalinae* which he separated as a subfamily from the Noctuidae, in which the tibia is spineless; other characters do not confirm the separability of the two subfamilies, and the present species, combining in its two sexes the characters diagnostic of Hampson's two subfamilies is one of many reasons for combining them as I have already proposed (1948), following the arrangement of McDunnough.

8.xii.44, and i.48, Buraiman (ARW); 29.i.48, Wadi Yemeniya, and 22.i.48, Birka (ARW); 1.ii.48, Madraqa (ARW); 29.iii.48, Shaq Yemeniya (BPU and ARW); 7.iii.45, Sabya, Asir (ARW); 30.i.48, Ashaira (ARW).

Eremic, Morocco to South Persia.

**157. *Cortyta acrosticta* Pung. (= *rosacea* Rebel).**

15.viii.43, Wadi Tabala, Asir (ARW); 10.iv.44, Hanakiya (DVF); 16.viii.44, Bisha, Asir (ARW); 8.xii.44, Buraiman (ARW); 16.ii.46, Rumaihiya, Nejd (DVF); 26.vi.48, near Najran (GP); 19.i.48, Buraiman (ARW); 1.ii.48, Madraqa (ARW).

Eremic, Morocco to Arabia; on *Acacia*.

**158. *Cortyta vetusta* Walker.**

14.iv.44, Hanakiya (DVF); 28.iii.48, Tihama of Asir (BPU and ARW); 29.i.48, Wadi Yemeniya (ARW).

Saharan-Sindian.

**159. *Cortyta dispar* Pung.**

8.xii.44, Buraiman; 29.i.48, Wadi Yemeniya; 30.i.48, Ashaira; 1.ii. and 24.ii.48, Madraqa; 16.viii.44, Bisha, Asir (all ARW); 14.ii.48, 90 miles East of Taif (GP). Richly variable.

Pan-Eremic, if the reported occurrence in Turkestan is correct; if not, certainly at least Saharan-Sindian.

**160. *Gnamptonyx vilis* Walker.**

14.viii.44, Harrat Bogum (ARW); 16.viii.44, Bisha (ARW); 15.viii.44, Taif (ARW); 26.ii.48, Madraqa (GP); 26.vi.48, Najran (GP).  
Saharan-Sindian; on *Acacia*.

**161. *Anydrophila* sp.**

16.iv.44, Jebel Jelf, near Hail (ARW).  
(Too eaten-up to identify certainly; resembles *bang-haasi* Brandt. from South Persia).

**162. *Anydrophila fouadi* Wilts. (1947) *grisea* Wilts. (1949).**

23.iv.44, Hail (ARW).  
Eastern Eremic, Sinai to South Persia.

**163. *Cerocala sana* Stgr.**

23.ii.44, Kuwait (VD); 24.ii.44, Mahz el Tain (VD); 12.iii.44, Kuwait (VD); i-ii.46, Hail, Artawiya, North Dahana, common (ARW., DVF., SGG).  
Eastern Eremic, Egypt to South Persia.

**164. *Leucanitis kabyalaria* B.-H.**

i.44, Hail; 3.iii.46, Jebel Shammar; ii-iii.46, Nejd and North Dahana, common; 6.i.46, Anaiza (SGG., DVF., IMcE).  
Eremic, North Africa to South Persia.

**165. *Syneda habibazel* Dumont.**

23.ii.46, Sayarat, North Dahana; 18.ii.46, Artawiya, Nejd (DVF); 3.iii.46, Jebel Shammar (SGG).  
Eremic, North Africa to Arabia.

**166. *Acantholipes circumdatus* Walker.**

27.iii. and 29.iii.48, Goz (BPU and ARW).  
Ethiopian or Eremic. Inhabits the Sudan.

**167. *Anumeta cestis* Men.**

ii-iii.46, Nejd, North Dahana, and Jebel Shammar (DVF, SGG).  
(DVF observed this species to settle in the sand by vibrating its wings and thus to become half-buried. It would then appear like a stone).  
Pan-Eremic.

**168. *Anumeta dentistrigata* Stgr.**

17.i.44, Hail (ARW); 20.ii.46, Hinna (IMcE); Dahana (DVF and SGG).  
An Eastern Eremic species, hitherto known only from the Central Asian deserts.

**169. *Anumeta fractistrigata* Alph.**

3.iii.46, Jebel Shammar (SGG); 23.ii.46, Sayarat, Dahana (DVF).

An Eastern Eremic species, hitherto only known from the Central Asian deserts.

**170. *Anumeta straminea* B.-H.**

20.i.44, Hail (ARW) ; 20.ii.46, Hinna (IMcE).

The first record from Arabia of a Saharan-Eremic species.

**171. *Metopistis picturata* Roths.**

23.ii.46, Sayarat, North Dahana (DVF) ; 22.iii.48, Wadi Sahba (H) ;

3.iii.46, Jebel Shammar. (SGG).

This too is the first record from Arabia of a North-African Eremic species.

**172. *Metoponrhis anartoides* Warn.**

xi-xii.44, Buramain (ARW) ; also a much smaller example, 1.ii.48, Madraqa (ARW).

Recently described from the Yemen. Does not appear to be a true *Metoponrhis*.

**173. *Proconis arabica* Wilts. (1949).**

30.i.48, Ashaira (ARW).

? Endemic South-west Arabian ?

**174. *Armada panaceorum* Men.**

20.iii.48, Jabrin road (H).

Pan-Eremic.

**175. *Armada dentata* Stgr.**

30.iv-2.v.48, Kuwait (EPW).

Eastern Eremic.

**176. *Armada maritima* Brandt.**

15.ii.48, Wadi Raniya, common (SGG) ; 30.iii.48, Goz (BPU and ARW) ;

8.xii.44, Buraiman (ARW).

Recently described from the South-Persian desert coast.

**177. *Armada waterstoni* Wilts. (1949).**

19.i.48, Buraiman camp ; 14.ii.48, Madraqa (ARW).

Apparently an endemic South-west Arabian species.

**178. *Raphia cheituna* Brandt.**

23.x.48, Kuwait (VD) ; 10.iii.44, Kuwait (VD).

A recently described Eremic species apparently confined to the shores of the Persian Gulf and South Persia.

**179. *Pandesma anysa* Guen.**

26.ii.46, Dahana (SGG) ; 3.iv.48, Qanuna (ARW and BPU) ; 26.vi.48,

Najran (GP).

Tropical migrant, also resident in Iraq.



**180. *Raparna coniocephala* Stgr.**

11.iii.48, Lith (GP); 26.ii.48, Madraqa (ARW).

Probably Saharan-Sindian, ranging from Spain to South Persia, and flying both sides of the Tropic.

**181. *Raparna erubescens* B.-H.**

29.i.48, Wadi Yemeniya (ARW).

Eremic.

**182. *Cosmophila flava* F. (= *xanthyndina* Butl.).**

1 ♂, 7.iii.45, Sabya (ARW); 1 ♀, 5.iv.48, Qanuna (GP).

The two sexes were originally described as different species.

Paleo-Tropical.

**183. Gen.? spec.?**

29.i.48, Bahrein Oasis (ARW).

**184. *Hypena obsitalis* Hubn.**

9.xii.44, Buraiman (ARW).

Mediterranean-Paleotropical.

**185. *Hypena lividalis* Hubn.**

19.i.48, Buraiman (ARW); 25.i.48, on *Zilla*, Wadi Hama, Hejaz (ARW).

Usually considered a Mediterranean species but also known from Socotra; usual foodplant: *Parietaria*.

**186. *Hypena masurialis* Guen.**

22.viii.44, 8000 feet, Abha (ARW); 7.iii.45, Sabya (ARW).

Paleo-Tropical.

**187. *Simplicia simulata* Moore.**

7.iii.45, Sabya (ARW).

This one specimen is the first Arabian record of a Tropical Indian species.

**Family : Lymantriidae****188. *Laelia innotata* Walker (= *flavipalpata* Stgr.).**

iv.48, Buraimi (T.); 12.viii.44, Wadi Hijla (ARW); 30.i.48, Ashaira (ARW); 1.ii.48, Madraqa (ARW); 28.iii.48, Shaq Yemeniya (BPU and ARW).

An Eremic moth feeding on *Acacia* and ranging from Arabia to the Atlantic.

The darker forms belong to *impura* Hering (synonyms *alfierii* Kruger and *brauni* Aud.).

**189. *Euproctis susanna* Stgr.**

15.v.44, in copula (but only one specimen), Nefud fringe, Hail (ARW).

An Eremic species probably a race of *fasciata* Walker 1855 from Sierra Leone, perhaps even a synonym thereof. The distribution therefore corresponds to that of the previous species, *innotata*, in total range, but within the area the species is far scarcer.

**Family : Arctiidae**

**190. *Spilosoma arabica* Hamps.**

19.i.48, Buraiman (ARW) ; 18.ii.48, Raniya (GP).

Red Sea Eremic, but not yet known from Africa.

**191. *Utetheisa lotrix lepida* Cr.**

13.x.46, Tihama near Jedda, disturbed from *Zygophyllum* (DVF) ;

28.iii.48, Shaq Yemeniya (BPU and ARW) ; 25.iii.48, Goz (BPU and ARW).

Paleo-tropical, probably a migrant.

**192. *Utetheisa pulchella* L.**

ii.45, Wadi Dhila, Asir (DVF).

A Paleo-tropical migrant, penetrating further north than the preceding ; it must be more widespread in Arabia than the material suggests.

**Family : Syntomidae**

**193. *Syntomis aurantiaca* Warnecke.**

30.vi.46, 10.000 feet, Suda (DVF).

Endemic Souh-west Arabian.

**Super-family : Anthroceroidea**

**Family : Gochlidiidae**

**194. *Coenobasis farouki* Wilts. 1947.**

1.ii.48, Madraqa (ARW) ; 29.iii.48, Goz (BPU and ARW).

Also known from Sinai ; though very distinct in colouring perhaps only a subspecies of *C. postflavida* Hamps. from Eritrea and other high parts of East Africa.

The genus is Ethiopian. The species (or race) seems to be West Arabian, including Sinai.

Probable foodplant : *Acacia*.

**Super-family : Pyraloidea**

**Family : Geometridae**

**Sub-family : Hemitheinae**

**195. *Neromia pulvereisparsa* Hamps.**

xi-xii, Buraiman (ARW) ; 30.i.48, Ashaira (ARW) ; 1.ii.48, Madraqa

(ARW); 19.i.48, Buraiman (ARW); 15.ii.48, Wadi Raniya (GP).

Eastern Eremic, from Egypt to South Persia.

**196. *Microloxia herbaria* Hubn.**

28.iii.48, Shaq Yemeniya and 31.iii.48, Wadi Qanuna foot-hills (BPU and ARW); 17.viii.44, Bisha, Asir (ARW).

Widespread in the Mediterranean, Tropical Africa and South-west Asia.

**197. *Hemidromodes robusta triforma* Wiltshire 1949.**

29.i.48, Wadi Yemeniya, and 19.i.48, Ashaira (ARW); 29.iii.48, Goz., and 3.iv.48, Wadi Qanuna (BPU and ARW).

Red Sea Eremic.

**198. *Acidaliastis micra* Hamps.**

22.viii.44, Wadi Hijla (ARW); 17.viii.44, Bisha (ARW); 10.xii.44, Buraiman (ARW); 16.i.48, Buraiman camp (ARW).

Eremic, inhabiting Arabia and N. Africa.

Sub-family : Sterrhinae

**199. *Sterrrha mimetes* Brandt subsp. *africarabica* Wilts. 1949.**

29.iii.48, Goz. (BPU and ARW).

Eastern Eremic, from the Tropical shores of the Red Sea to South Persia.

**200. *Sterrrha sordidior* Wilts. 1949.**

8.xii.44, Buraiman (ARW).

Red Sea Eremic, described from South-east Egypt.

**201. *Sterrrha illustrior* sp. n. (Plate, fig. 1).**

Face, black; female antenna, simple.

Head and thorax, bone white.

Forewing, bone white, finely powdered with ochreous and greyish black scales on the fasciae and towards the termen; ante-median fascia represented by a few black scales only. Discal spot, distinct, placed on the median shade which is clearly defined except near costa. Post-median fascia, pale ochreous-brown, with black dots on the nervures. Marginal fields, duskier. Termen, white, fringes, dusky, with black dots at the base, at the end of the nervures.

Hind-wing, with discal spots darker than on fore-wing and with ante-median fascia strikingly suffused with blackish towards the anal margin, just passing inside the discal spot. Post-median fascia, termen, and fringes, as fore-wing.

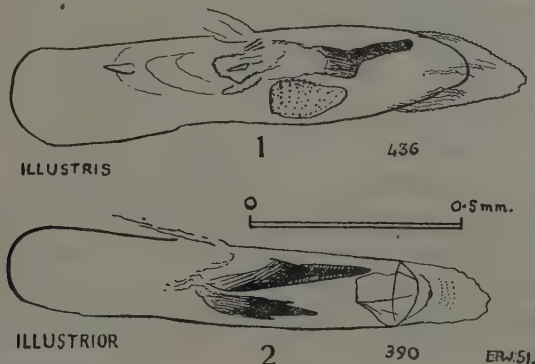
Undersides, both wings, with clear black discal spots. Fore-wing, with post-median fascia clearly defined; hind-wing, with both ante-median and post-median fasciae clearly defined.

Span : 11 mm.

Holo-Type: ♂ (genitalia illustrated), 8.xii.44, Buraiman (ARW), in coll. m.

Allo-Type: ♀, 8.xii.44, Buraiman (ARW) (presented by M.E.A.L.U. to British Museum, London).

Para-Types: 1 ♀, 28.iii.48, Buraiman (ARW) (presented by M.E.A.L.U. to British Museum, London). Also 2 examples, 17.xi.31, Mecca (leg. H. St. J. Philby), in British Museum.



Figs. 1 and 2: ♂ genitalia, aedeagus only, of *Sterrha* (1) *illustris* Brandt, and (2) *illustrior* sp. n.

In facies and structure this new species comes close to *Sterrha illustris* Brandt 1943, from South Persia.

In facies, it can be distinguished by the heavier black cell-spot on the hind-wing, and the rounder fore-wing shape.

In structure, the aedeagus of the male genitalia provides the best characters for distinguishing *illustrior* (Fig. 2) from *illustris* (Fig. 1). While the latter has a small lightly chitined backward pointing cornutus, a large, heavily sclerotised branch-like cornutus, and a pear-shaped scobinated cornutus, the new species has a heavily-sclerotised dagger-like cornutus and a shorter three-pointed heavily sclerotised cornutus only.

## 202. *Sterrha* (?) *allongata* Stgr.

23.ii.46, Ras Safaniya (IMcE).

The species, whose identity is still uncertain, is probably the same as "*Limeria macraria*" Turati (nec. Stgr.). The span is 24 mm., considerably larger than Persian *S. allongata* Stgr.

## 203. *Sterrha sahotaria* Stgr. f. *crasssquama* Warr. and Roths.

29.i.48, Wadi Yemeniya (ARW), 26.ii.48, Madraqa, (GP).

Eastern Eremic.

**204. *Brachyglossina* sp.**

26.ii.48, Madraqa (ARW).

A single female, perhaps a new species near *chaspia* Brandt.

**205. *Oar pratana* Prout subsp. *obscuraria* Baker.**

11.iii.48, Lith (GP); 27.iii.48, Tihama of Asir (BPU and ARW).

Eremic, from Arabia to North Africa.

**206. *Scopula nepheleperas* Prout.**

29.i.48, Wadi Yemeniya (ARW).

The first Arabian record; Ethiopian.

**207. *Scopula luridata* Z.**

22.viii.44, Wadi Hijla (ARW).

An East Mediterranean and Tropical Eremic moth.

**208. *Scopula* (?) *serena* Prout.**

29.i.48, Bahrain oasis (ARW); 29.iii.48, Goz (BPU and ARW).

If this identification is correct, the species is Tropical African.

**209. *Glossotrophia buraimana* Wilts. 1949.**

xii.44, Buraiman (ARW); 29.i.48, Ashaira, and 1.ii.48, Madraqa (ARW);

26.ii.48, Madraqa (GP).

Endemic Arabian, Eremic.

**210. *Glossotrophia uvarovi* sp. n. (Plate, fig. 2).**

Male antenna, with profuse fascicles of cilia.

Fore-wing, pale ochreous, slightly powdered with grey scales, especially on the fasciae and median and submarginal shades, or (in the case of one para-type ♂) strongly bleached so that the median shade, post-median fascia, and submarginal shade are almost invisible; in these bleached forms however, the discal spot remains conspicuous. Discal spot, black, emphatic. Post-median fascia, denticulate, mostly sharply angled outwards on nervure 6; the ante-median and post-median fasciae and median shades proceed from dark costal spots. Termen, a black line, running round apex but interrupted below this on the outer margin.

Span: 15 mm.

Holo-Type: ♂ (genitalia illustrated), 29.iii.48, Goz (BPU and ARW), in coll. m.

Allo-Type: ♀, 31.iii.48, Qanuna Khalt, Asir Tihama (BPU and ARW), presented by M.E.A.L.U. to British Museum.

Para-Type: ♂, 25.iii.28, Wasita, Hejaz (leg. H. St. J. Philby), in coll. British Museum.

Whiter and smaller than the other Arabian *Glossotrophia* moths, coming in the *alfierii*-group. The heavier black cell-spot on the forewing seems to distinguish it. The markings are darker than in *alfierii* Wilts.



The eighth sternite suggests close affinity to the ~~two~~ moths just named. The male genitalia of *Gl. alfierii* mea were shown in fig. 104 in "The Lepidoptera of the Kingdom of Egypt", Part II (this Bulletin, XXXIII, 1949).

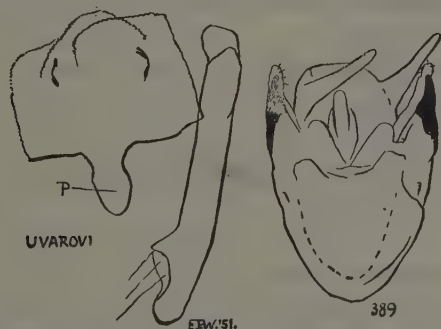


Fig. 3 : *Glossotrophia uvarovi* sp.n. ♂, 8th sternite and genitalia, ventral view, with aedeagus separated (P = projection of the base of the 8th sternite).

In *uvarovi* sp. n., both cerata are also quite undeveloped but the projection of the base of the eighth sternite is less semicircular, more oval; it has a distinct neck (See fig. 3).

**211. *Pseudosterrha paulula* Swin.**

27.i.48, Birka, and 30.i.48, Ashaira, and 26.ii.48, Madraqa (ARW);  
27.i.48, Buraiman (? ARW).

Sudanian-Deccanian.

**212. *Traminda rufistrigata* Hamps.**

xii.44, Buraiman (ARW); 18.i.48, Buraiman (ARW); 29.i.48, Wadi Yemeniya, and 30.i.48, Ashaira (ARW); 15.ii.48, Wadi Raniya (GP);  
29.iii.48, Goz (BPU and ARW).

Red Sea Tropical-Eremic, reaching South Persia.

**213. *Traminda mundissima* Walk.**

4.i.44, Ras el Khaima, Trucial Oman (DVF).

Tropical.

Sub-family : Larentiinae

**214. *Lithostege fitzgeraldi* Wils. 1947.**

18.ii.46, Artawiya (DVF); 26.iii.48, Hail (JDF); 18.i.44, Hail (DVF and ARW).

Eastern Eremic, apparently confined to Arabia and perhaps Southern Iraq.

**215. *Lithostege notata* Bang-Haas.**

30, 31.xii.43, Burqan, near Kuwait (VD); 24.ii.44, Mahz el Tain (VD);

17.i.44, Hail (DVF and ARW); 3.ii.46, Lina, and 2.ii.46, Hafar, and 8.ii.46, Maagala (IMcE).

Eremic, from Bushire to North Africa.

**216. *Lithostege palaestinensis* Ams. ali Wilts. 1941.**

2.ii.46, Hafar (IMcE).

Eastern Eremic, Palestine to South-west Persia.

**217. *Eupithecia tenellata* Dietze.**

21.ii.46, Dahana (DVF).

The first Arabian record of a Saharan moth.

Sub-family : Geometrinae

**218. *Lomographa senaarensis* (Rebel).**

i.43, 60 miles north-east of Mecca (BPU); 22.viii.44, Wadi Hijla (ARW); 29.i.48, Wadi Yemeniya, and 30.i.48, Ashaira (ARW).

Tropical, described from the Sudan.

**219. *Epignopteryx flavedinaria* Guenée.**

1948 (GP), a rubbed large yellowish specimen, locality and date not given, but doubtless from Asir.

Ethiopian.

**220. *Macaria trizonaria* Hamps.**

13-16.x.43, Dhofar (DVF).

Ethiopian.

**221. *Macaria aestimaria* f. *sareptanaria* Stgr.**

7.iii.45, Sabya (ARW); iii.iv.48, Wadi Yiba and Qanuna (BPU and ARW).

The form also occurs in South-east Russia, but more normal forms occur between that region and the Arabian localities. I incline to regard it as a colour-form due to environmental influences and not a good subspecies. The genitalia are identical with that of other *aestimaria* forms, and quite distinct from those of *syriacaria* Stgr. b. sp. which has a different foodplant and larva.

Mediterranean and Pan-Eremic *Tamarix*-feeder.

**222. *Coenina paulusi* Rebel.**

29.i.48, Wadi Yemeniya (ARW).

Dr. Reisser at my request kindly examined Rebel's type in Vienna (a ♀), and discovered that its antennae are not as described by Rebel, and copied by Sèitz, but bipectinate, thus agreeing with this single female.

Previously only known from Palestine. Presumably an *Acacia*-feeder. Red-Sea Eremic.

**223. *Coenina dentataria* Swin.**

29.i.48, Wadi Yemeniya (ARW).  
Red-Sea Eremic, an *Acacia*-feeder.

**224. *Boarmia tenuisaria* Stgr.**

20.ii.46, Hinna (IMcE).  
An Eastern Eremic *Lycium*-feeder.

**225. *Tephрина disputaria* Guenée.**

10.xii.44, Buraiman (ARW) ; 4.ii.46, Maagala (IMcE) ; i-ii-iii.48, Wadi Yemneiya, Birka, Buraiman, Qanuna, Wad Yiba, Goz (BPU and ARW) ; 26.vi.48. Najran, (GP).  
Very variable.  
Sudanian-Deccanian, on *Acacia*.

**226. *Tephрина sublimbata* Butler.**

Under this name must be classed, on structural grounds, two forms. The first, of which there is one example (29.iii.48, Goz (BUP and ARW)) is smaller, pale yellowish and faintly marked. The second, which is rather

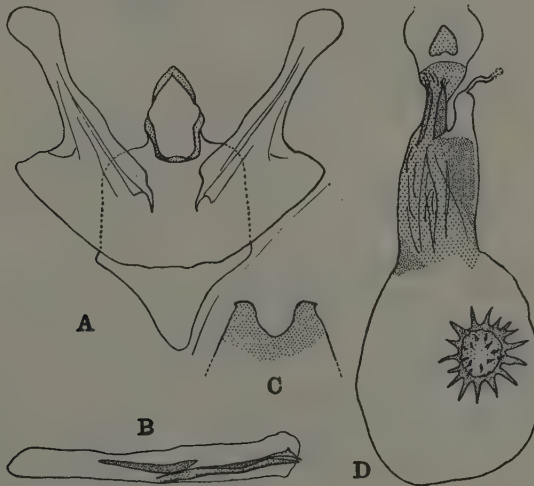


Fig. 4 : *Tephрина sublimbata* Butler genitalia (a = ♂ genitalia, ventral open position with aedeagus removed; b = aedeagus; c = octavals; d = ♀ genitalia) [Butler's holotype].

large and greyish (being more monotonous in aspect and larger than *disputaria* from the same localities) is illustrated in the Plate (fig. 3), and superficially strongly resembles *deerraria* Walker which, structural examinations by Mr. Fletcher show, is no more than a paler race of the Ceylonese

species *T. pulinda* Walker. The genitalia of both sexes of these two species, drawn by Mr. Fletcher, are shewn in Figs 4 and 5, so that it will henceforth be possible to separate these two confusing species. The genitalia of *disputaria* Guenée have already been figured by Jansé (1932 : The Moths of South Africa, Vol. 1), but that species can also be distinguished superficially from *sublimbata* and *deerraria*. In the male genitalia, the produced

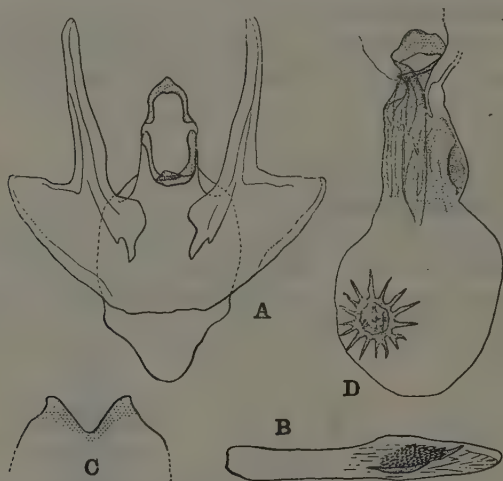


Fig. 5 : *Tephрина pulinda* subsp. *deerraria* Walker : genitalia (a = ♂ genitalia, ventral open position with aedeagus removed; b = aedeagus; c = octavals; d = ♀ genitalia).

costa of *sublimbata* is apically a rounded lobe, while that of *pulinda* tapers apically. The aedeagus of *sublimbata* possesses three cornuti, all tapering spines, two being one third and one one half as long as the aedeagus; that of *pulinda* has two cornuti, one a sclerotised spine one quarter as long as the aedeagus and the other multiple, being a cluster of teeth tipped with a stout spine. The female genitalia of the two differ most markedly in the ostium bursae; in *pulinda* the rim of the orifice is strongly sclerotised and without an operculum; that of *sublimbata* is weak with a well sclerotised triangular operculum.

Examples of the greyer form are : 25.i.48, Wadi Hama; 29.i.48, Wadi Yemeniya; 1.ii.48, Madraqa (ARW). The same species also occurs in Morocco where it has been bred by Monsieur Charles Rungs for several years. We were proposing to name it after Mr. Fletcher when Mr. Fletcher's own researches in this genus shewed it to be *sublimbata*, of which the unique type, a female, was examined in the British Museum.

**227. *Zamarada secutaria* Guenée.**

i.45, 18 miles east and 60 miles north-east of Mecca (BPU); 19.i.48, Buraiman and 30.i.48, Ashaira (ARW).

Red Sea Eremic.

**228. *Osteodes latimarginaria* Rebel.**

23.viii.44, Khamis Mushait (ARW); i.45, 18 miles east of Mecca (BPU); 3.ii.46, Lina (IMcE).

Endemic Arabian.

**229. *Dyscia plebejaria* Ob.**

3.iii.46, Jebel Shammar.

The Saharan form, which extends from North Africa to Mosul, of a species of Eremic range which, in another race, also inhabits Transcaucasia.

**Family : Pyralidae**

A few of these have been identified, but most must await the inspection of a specialist.

**230. *Galleria melonella* L.**

8.xii.44, Buraiman (ARW); 29.i.48, Wadi Yemeniya (ARW).

This moth is a bee-hive inquiline; since there is said to be no cultivation at its places of capture in Arabia, these raise an ecological problem. Perhaps they indicate that Arabia is its original home, before it attached itself to human culture.

**231. *Hellula undalis* F.**

8.xii.44, Buraiman (ARW).

**232. *Cornifrons ulceratalis* Led.**

xi, xii.43, Kuwait (VD); 2.ii.44, Suda, East Arabia (VD); 10.ii.44, Bajsa (VD); 24.ii.44, very common, Mahz el Tain (VD); 18.i.44, and 30.i.46, Hail (ARW, DVF, SGG); 3.ii.46, Lina (IMcE); 22.ii.46, Dahana (SGG); 19.ii.46, Awaniya (IMcE); 9.ii.46, Rumaihiya (SGG); 21.iii.48, Jabrin oasis (H); 25.iii.46, Hail (JDF); 6.v.48, Bass (JDF); i.45, Sharaya, 18 miles east of Mecca (BPU); 22.i.48, Birka (ARW); 14.ii.48, 90 miles east of Taif (GP); 15.ii.48, Wadi Raniya (GP); 26.ii.48, Madraqa (GP).

The commonest desert moth. Eremic, widespread in the Old world.

**233. *Nomophila noctuella* Schiff.**

24.ii.44, Mahz el Tain (VD); 22.ii.46, Abu Hadriya (IMcE); 19.ii.46, Awaniya (IMcE).

A very widespread migrant.

**234. *Trienoneura albofascia* Rebel.**

8.xii.44, Buraiman (ARW).

Described from Egypt.



**235. *Emprepes russulalis* Chr. (= *baryscia* Meyr.).**

10. and 15.iii.44, Kuwait (VD).

**Super-family : Gelechioidea**

These also must be left unnamed at present.

**Super-family : Tineoidea****Family : Psychidae****236. *Dasaratha arabica* Wilts. 1949.**

12.xii.44, Buraiman (ARW).

**Families : Tortricidae, Talaeporiidae, Phyllocnistidae,  
Gracilariidae, Tineidae, and Glyphipterygidae**

These cannot be named at present. No species of the family Aegeriidae was taken.

**Family : Cossidae****237. *Cossus cheesmani* Tams.**

10.iv.46, Medain Salih (DVF).

A rare Eremic moth, only known previously from the Nejd.

**238. *Holcocerus gloriosus* Ersch. *laudabilis* Stgr.**

Two females, 6 and 22.v.48, Rass (JDF).

Pan-Eremic.

**239. *Hypopta reibelli* Ob. (= *Eremocossus proleuca* Hamps.).**

22.i.44, Shinas (DVF); 19.xii.44, Buraiman (ARW).

Eremic, inhabiting the Sahara and Arabia.

**240. *Dyspessa kabyliaria* Bang-Haas.**

23.ii.46, Sayarat (DVF); 6.v.48, Rass (JDF).

The genitalia agree with those of Egyptian specimens.

**241. *Dyspessa* ? *asema* Pung.**

15.ii.48, Wadi Raniya (GP).

A good series was taken near Kuwait by VD in 1942 of which the abdomens were eaten. This is the same species as that from Iraq which LeCerf determined as *asema* Pung. Examples in the British Museum under that name, however, from Tedjen Oasis, Transcaspiia, seem to be distinct.

*Lepidoptera recently taken in Arabia*

E. P. Wiltshire

Plate



Fig. 1 : *Sterrhia illustrior* sp. n., ♂. — Fig. 2 : *Glossotrophia uwarovi* sp. n., ♂. —  
Fig. 3 : *Tephрина sublimbata* Butler.



# Early stages of Palearctic Lepidoptera, X<sup>(1)</sup>

(with Plate)

by E.P. WILTSHIRE, F.R.E.S.

The species dealt with here, were studied in Egypt, Cyprus and Persia. In most cases the early stages were previously quite unknown.

## NYMPHALIDAE

### *Melitaea arduinna* Esper.

The ova are laid in dense masses, sometimes piled four rows deep, on the underside of the foodplant leaf; the ovum is pale green, round and glossy.

The freshly hatched larva is pale ochreous with whitish hairs and a pale brown head marked on each side with a dark brown spot.

The larvae are gregarious and very subject to apantelid parasites. The full-grown larva is velvety black above the black spiracles, yellow-grey below them; but both these fields of ground colour prove, on closer inspection to be mottled with several colours, e.g. grey, black, ochreous; only the dorsal line is pure black. The dorsal warts and spines are ochreous-grey.

The foodplant is *Untaurea behen* L. <sup>(2)</sup>, a tall and very local plant with very large leaves; it grows in masses on the slopes near the vineyards and in scattered groups in the vineyards themselves near Masjid-i-Bardi and Murdaraz, 5500 feet, near Shiraz, north slopes of Kuh Barfi, originally an oak wood.

The identification of the above larvae with the butterfly found in close association with the foodplant and nowhere else near Shiraz is circumstantial; the heavy mortality made positive proof impossible to obtain, but I have absolutely no real doubt. The young larva will eat only this one species

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<sup>(1)</sup> The previous article in this series appeared in *Ent. Rec.* LX (January 1948) being illustrated by Plate V, vol. LIX (October 1947).

<sup>(2)</sup> The Botanical Section of the British Museum (Natural History), have kindly determined this foodplant.

of *Centaurea* which is so local and difficult of access that breeding is a problem; the larvae which I found full-grown on the plant were all parasited.

In an early year at Shiraz (e.g. 1941) the larvae are full-grown in April: but in a late year (e.g. 1950, after a severe winter) the imago was seen out on 21st April and larvae hatched from ova on May 7th. At 9000 feet in the Elburz Mts., N. Persia (Lar valley), I took one female in early vii.1939. I consider all these to be first brood butterflies and do not think it has more.

### LEMONIIDAE

#### *Lemonia peilei* subsp. *farsica* mea 1946.

I have now reared this race from ovum to adult, and I find that the full-grown larvae agree perfectly with the Qizil Robat (Iraq) larva illustrated and discussed in my article "Middle East Lepidoptera, V" (*Proc. R. Ent. Soc. London* (B), pts. 9-10, Oct. 1946). This confirms that *farsica* is conspecific with *peilei* Roths.

I now give fuller details of the early stages and life-history, but refer readers, for the photograph, to the 1946 article just mentioned.

Ovum, bun-shaped, glossy like porcelain, at first pinkish brown with darker brown apical dot surrounded by a whitish-suffused ring and a similar wider lateral ring, dark-edged above.

The ova are laid in batches, and hatch in mid February, after three months.

The freshly-hatched larva is uniformly black with whitish hairs. In the second instar, paler dorsal warts appear. The pairs of dorsal warts are orange-brown and larger on the thoracic somites, whitish and smaller on the abdominal.

The full-grown larva has an orange-brown head; it is sooty-grey or dull black, with a darker black dorsal line interrupted at the somital joints. Soft pale brown or whitish hairs spring from large brown warts. There is a subdorsal series of white streaks, black-edged below; each streak consists of a purer white dot separated by the somital joint from a less pure white wedge-shaped streak pointing backwards. Spiracles, black; below them, a vague pale grey line; above them a similar lateral line.

Foodplant: *Taraxacum*, *Lactuca*, etc.

In Fars the pupal diapause lasts from April to November. Both sexes of the moth come to light after sunset in the latter month; the moth is univoltine autumnal.

### ZYGAENIDAE

#### *Zygaena seitzi* Reiss. (Plate, fig. 5).

The full-grown larva is one inch long, green, with a dorsal chain of



pale yellow marks, two per somite, and a pale yellow subdorsal chain of marks. The head and setae are black, the hairs white or black. The subdorsal marks are large and diffuse, the anterior on each somite fainter, longer and more diffuse, the posterior oval, sharper, paler. The dorsal marks consist of a small distinct posterior central spot and a more diffuse circumflex on the anterior part of each somite, upon which the dorsal setae are placed.

The oval-based cocoon is white and papery. The moth from a larva which spun up on May 25th hatched on June 8th.

The foodplant is a large yellow-flowering umbellifer found at 7000 feet and higher on the Shiraz mountains; my identification of it is *Prangos ferulacea*.

The larva, like the imago, is taken only in single specimens; the moth flies in June on the higher mountains around Shiraz.

#### AGROTIDAE

##### *Amathes xanthographa* Schiff. and *pulverea* Hamps.

The larva of the first is well-known; the larva of the second has been inadequately described in an earlier article in this series (*Ent. Rev.*, June 1946), and I now give a photo of both larvae to show the great differences between them. Both moths fly together on oasis and scrub woodland biotopes the whole length of the Zagros mountains; the photos show two larvae from my garden in Shiraz. The two species also occur together in the Lebanon, and Cyprus. For many years they were confused (see Boursin XXV (1940) for the structural differences between the moths, *Rev. Fr. d'Ent.*, VII, pp. 86-93, plates III, IV).

The larvae of the two species can be immediately distinguished by the direction of the subdorsal black smudges; in *xanthographa* (Plate, fig. 1) these are weaker and parallel to the longitudinal stripes and tend to form a black stripe; in *pulverea* (Plate, fig. 2) they are placed obliquely; the posterior two (or sometimes four) pairs are much heavier and thicker.

The following is a fuller description of the *pulverea* early stages:

The ova are laid in batches, usually rather crowded. The ovum is at first white, then pale brown. Closer inspection shows it to be grey in ground-colour, with a brown apical dot and ring, and clear sculpture; it is of the usual bun-shape. It hatches in two weeks.

In the second instar the caterpillar is already light brown but otherwise not like the full-grown; the setae are black and there is a continuous but not strong whitish dorsal line. The dark lateral shading just above the broad white spiracular stripe provides the most salient marking at this stage.

When full-grown, the larva is of a warm brown colour, sometimes yellow-brown. The amount of black marking is fairly variable. In all larvae,

the pair of subdorsal black smudges on somite 10 is the most heavily defined; in most, they are strong on somites 8-11, i.e. four pairs of smudges are strongly defined; the pair on somite 11 is smaller and of a different form. From somite 7 forwards, the black pigment is lacking from these smudges almost invariably. The setae are half-black, half-white. The whitish dorsal line, with fine darker edges, is almost invariably continuous; my 1946 article described an exception where this line was interrupted. Its coloration varies from dirty to purer white. The subdorsal lines are more faint. The spiracular wavy stripe is, in the final instar, of variable intensity and more outstandingly pale in the darker forms. Usually the lateral area is darker than the dorsal, and thus contrasts with the spiracular stripe. The head is glossy brown, marked with darker.

Foodplants : low herbs and grasses. It feeds at night.

The cocoon is formed in about March in the grass roots; the pupa is glossy red-brown, not very strongly chitined. The moth, like that of *xanthographa* in the localities mentioned, flies in October (September in the higher Cyprus mountains); they are univoltine autumnal moths.

#### ***Sidemia apothaina* Brandt (Plate, fig. 4).**

The ovum is yellowish-white, bun-shaped, with extremely fine and faint sculpture, and with reddish apical dot. The ova are laid in cracks and corners, in mid-October. They hatch in November after a period varying between 22 days and 38 days; it appears that they will hatch sooner if kept damp.

The freshly hatched larva is dark grey with a glossy black head. The thoracic feet and abdominal claspers are all grey. Darker longitudinal stripes leave a broad pale grey dorsal area. After eating they became greenish.

Foodplants : various low herbs including *Compositae* and *Papilionaceae*.

The striped appearance is lost as the larva grows bigger. The larva is similar in the last three instars except that in the last instar the subdorsal lines become less conspicuous and the spiracles become more conspicuous, being black-rimmed. The feet, both thoracic and abdominal, are also less marked in the last than the third instars. Otherwise, the following description may apply to these three instars : olive-grey with black markings; setae dark and clear; a wavy creamy double spiracular stripe has an interrupted black upper edging; the dorsal line is concolorous and has a fine dark edging but subdorsals are paler centred, with dark edging. The edging of the dorsal line darkens to black on the somital joints. The hairs are brownish; the feet are brownish or olive, with black spots most distinct in the third instar. In captivity they reached full-growth in December or January but doubtless in the wild state they mature a month or two later than this.

The moth flies for a brief period in October, being univoltine autumnal. In Fars it inhabits hilly steppe at 5000-6000 ft.

***Minucia bimaculata* Osthelder (Plate, fig. 7).**

All ten abdominal feet of the larva are developed but those on somite 6 are less big. The larva is coloured pale grey with dark grey and black markings consisting of longitudinal lines and dots: most conspicuous are the black lines above the subdorsal lines on somite 4 which form a black dorsal lyre-mark. A dark grey suffusion on the posterior part of somite 9 and anterior part of somite 10 covers the sides and back; on somite 11 there is a transverse ridge. Lateral and subdorsal lines have a brown centre edged outside with white; all lines consist of dots or wavy lines. Spiracles, almost invisible.

The larva feeds at night on *Pistacia mutica* but can be eaten out of this tree by day. It is full-grown in May and then forms a large firm earthen cocoon in which the pupa undergoes a diapause of at least seven months. The pupa is 20-23 mm. long, of a purplish-brown hue with a whitish-mauve bloom, and with six anal hooks in a row, of varying size, the outer ones being little more than stiff hairs.

Imagines emerged in captivity in late January and mid February but doubtless in the wild state they hatch a little later than this, probably considerably later at the higher elevations. In Fars it inhabits the scrub-wood zone from 4000 to 8000 feet.

It may be useful if I give the larval differences between the above species and *Anua tirhaca* Cr.; both species feed on *Pistacia* in the Middle East, and have large, recognisably Catocaline, larvae. The head of *tirhaca* usually bears two yellow spots; the spiracular line is edged heavily with black on somites 1-5; the dorsal ridge on somite 11 has two distinct points. I have myself, before succeeding in breeding out imagines of *nigritimaculata*, confused the larvae of the two species and my remarks in my Iraq List (1944) about *tirhaca* larvae feeding on high mountain trees in South-west Persia should be corrected to refer to *nigritimaculata*, although Brandt has taken *tirhaca* in South-west Persia and doubtless it feeds there on *Pistacia mutica* or *khinjuk*. I do not now think that the *M. nigritimaculata* larvae which I found at 8000 ft. in May 1941 had hibernated as larvae. *M. nigritimaculata* is univoltine vernal; *A. tirhaca* is multivoltine.

***Clytie sancta* Stgr. (Plate, figs. 8, 9, and 10).**

In my first article in this series (1935) (*Ent. Rec.*, XLVII) and my third (1939) (*Mitt. Muench. Ent. Ges.*, XXIX, 1), I have said a few words about, but given no photograph of, the larva of this species. I found the

larva again in 1948 in Cairo, and can now give a more detailed description with illustrations.

The mature larva, especially in its darker form, is very similar to that of *C. syriaca* Bugn., described and illustrated in my 1939 article. The differences which I there suggested as distinguishing *sancta* from *syriaca* do not apply to all specimens, as the coloration of *sancta* is rather variable. Instead, while stressing the great similarity, I would now suggest that the following differences should be looked for, by persons not able or not anxious to resort to microscopic dissection :

|                                                            | <i>sancta</i>                                           | <i>syriaca</i>                                                                      |
|------------------------------------------------------------|---------------------------------------------------------|-------------------------------------------------------------------------------------|
| Broad pale dorsal stripe ...                               | borders, wavy but not so as to narrow stripe very much. | borders, contracted at somital joints, making stripe resemble a string of sausages. |
| Dark dorsal stripes, on upper edge of subdorsal stripes... | narrower; in paler form, not much darker.               | broader.                                                                            |
| Subdorsal spot on somite 4.                                | larger; not a perfect circle.                           | clearer; circular.                                                                  |
| Spiracles .....                                            | dark brown, black-rims; conspicuous.                    | grey with pale rims; not so conspicuous.                                            |

A fuller description of *U. sancta* larvae now follows : the immature larva (Plate, fig. 8) is green, as in the case of other congeners; of the white longitudinal stripes, the double dorsal line is the most continuous (not as in *C. delunaris* Stgr., and *Hypoglaucitis benenotata* Warren); this stripe is interrupted at the somital joints on somites 4 and 5 and is almost absent on 1 and 2; the subdorsal white stripes are strongest on somites 1 and 2 and absent or weaker thereafter. Head, with four (dorsal and subdorsal) white stripes. Somites 10 and 11, white-dotted transversely. White subdorsal spots on somite 4, very conspicuous. Larvae longer than 1 inch became brown.

The mature larva is brown and variable, either with stronger dark striping (Plate, fig. 9) or more uniform (Plate, fig. 10). In the dark form the white setae show up very clearly in the dark grey stripes. Ground colour, fawn, with creamy lines, purple-edged and with orange-mottled central markings; the subdorsal spots on somite 4 and the orange-mottled central strand to the creamy dorsal stripe are perhaps the most outstanding features in the more uniform, paler form. Setae, a fine black point circled with white. Spiracles, dark brown, black-rimmed. On somites 10 and 11, two white dorsal stigmata on each, heavily purple-edged. Thoracic legs, pale, ochreous; femur and tibia bulging thickly. Abdominal feet, mottled like the rest of the body, with reddish uniordinal crochets; the pair on the third abdominal somite is smaller. Pupal period, in September, a fortnight.

Foodplant : *Tamarix*.



***Pericyma albidentaria* Freyer (Plate, fig. 11).**

This larva has been described before, but, perhaps due to abbreviation in copying, the account most readily available is somewhat misleading, so I redescribe it.

It is green, even when mature; it has only three pairs of claspers or abdominal feet. On somite 7 there is an obsolete pair: on somite 6, none. Spiracles, small, white, black-rimmed, placed on the sublateral stripe. Dorsal lines, very faint, consisting of a whitish green dorsal line edged with darker green. A creamy paler green conspicuous sublateral stripe runs from the head to the feet on somite 8, where it ends. A similarly coloured short stripe runs down the side of the feet on somite 9. The sublateral stripe resumes its normal course on somite 10 and runs to the anal feet. The abdominal feet are purplish tinged. Head and thoracic feet, green.

Foodplant: *Alhagi*.

Cocoon, thin, not quite opaque, among twigs or leaves.

Pupa, at first glossy green, then purplish-brown. Period, in midsummer, eight days.

These observations were made at 5000-6000 feet near Shiraz. The moth is widespread in the Middle East, over a great range of altitudes; it is multivoltine all the summer.

***Arcyophora dentula* Stgr.**

On 24th June 1950 a green larva was found crawling on a garden wall in Shiraz. The garden was full of apple, and poplar trees. The larva pupated before it could be photographed or described in detail. The moth emerged on July 6th. It is a multivoltine garden moth, inhabiting Iraq and Persia. I suspect that it feeds on various fruit-trees, including pomegranate. It is now clear that it is not an internal feeder but a normal leaf-feeder.

**LYMANTRIIDAE*****Ocnèria terebynthina* Stgr. (Plate, fig. 3).**

In my fifth article in this series (1943) (*Journ. Bombay Nat. Hist. Soc.*, XLIII, 4) I described the ova of *Ocn. insolita* Brandt. Further experience in the district has convinced me that *insolita* is an extreme bleached dwarf second brood form of *terebynthina* Stgr., and that the name cannot be used to denote the Fars race, for in this race normal *terebynthina* forms are quite frequent, especially in the first generation and in cooler, wetter seasons.

The ova are laid in a neat regular batch in diamond-formation; the ovum is bun-shaped, glossy, pale cinnamon-grey; it hatches after one week.

The larva is blue with conspicuous subdorsal brown warts circled with black and soft whitish hairs. Head, black. Dorsal area, creamy white on somites 2-3 and 5-9. There are black vertical lateral pencilings on the poste-



rior part of each somite, and a pencilled horizontal black bar below the wart on each somite. Somites 9 and 10 each bear a reddish dorsal gland or tubercle, which appears liquid and in constant slight movement. Between these two glands, at the somital joint, a small creamy white spot. Thoracic feet, pale. Length of full-grown male larva, 1 inch.

The larva chose its pupation-place on 27.v., started constructing the cocoon on 28.v., and pupated inside it on the night 29-30.v. The moth emerged 7.vi. The cocoon is a transparent cradle, horizontal, consisting only of a few threads. The pupa retains many larval characteristics, except head and legs; it is blackish, with ochreous subdorsal warts and a pale dorsal patch; hairy; 19 mm. long. Cremaster, long, cylindrical, with a tuft of bristles on the extremity.

Foodplant : *Pistacia mutica* (in captivity can be reared on cultivated *Pistacia*).

The moth is bivoltine, the first brood flying in June. The smaller second brood flies in August at 5000-6000 feet in Fars but I have taken it at 1000 feet in October; at this low elevation, where the summer is so hot and dry the first generation probably flies a month earlier i.e. in May. In Kurdistan, the more northerly latitude produces an equivalent biotope at a lower height than in Fars, and the first generation flies at 1500-3000 feet in June. Perhaps in these northern localities the white forms do not occur. In Fars some of each generation are white in ground colour, while others are grey, at least in some years.

#### GEOMETRIDAE

##### ***Sterrhia mancipiata* Stgr. subsp. *repagulata* Prout (Plate, fig. 6).**

The larva is buff-coloured and fond of curling or half-curling. The skin is ridged transversely. Markings may be light or heavy. The dorsal line is double, black, continuously brown-suffused, with a heavier suffusion in the middle of each somite. On somites 4-9 a dark brown lateral stripe is marked with seven spaced blackish suffusions corresponding to the dorsal marking, but in lightly-marked forms, there are not seven but five, i.e. only on somites 4-8. Stigmata, black. Subdorsal lines appear in the last instar; they are faint, grey-centred, paler-edged, with blackish marks here and there. A blackish lateral suffusion on the lateral stripe appears in the last instar on somite 1.

From ova laid in Tehran at about 4500 feet, larvae were full-grown in mid vii and produced a second generation of moths on 27, 28.vii.

Foodplant : various low herbs.

Biotope, oasis gardens in North Persia.

The identity has been ascertained by a comparison of the genitalia with Prout's type.

**Eupithecia relaxata Dietze.**

The larva is pale yellowish green, with pinkish infusion. Dorsal line, faintly purplish, clearly purplish at anal flap. Spiracles, black. Sublateral ridge, very slightly paler, wavy, irregular. Skin, transversely folded. The dorsal stripe on closer inspection proves to be faintly paler-edged, the edging having a further faint purplish outer edge.

Foodplant : *Amygdalus spartioides*.

Phenology : two generations, the second being smaller. Larvae found in scrub woodland at Sarvistan at 6000 ft., Fars, pupated in v.50 and hatched in xi.50. In mild localities, e.g. Khafr, 4000 feet, Fars, I have taken the first brood to light on 28.ii.50, and at Shiraz (5000 ft.) it is common from early iii. till late in iv.; the second generation is usually seen in x. It inhabits both steppe mountain and gardens and probably has a number of alternative foodplants to that mentioned, which is not to be found in all the places where I have taken the moth.

**Genus Epithierina Wehrli.**

In 1941 geometrid larvae were found on *Pistacia mutica* and various wild *Amygdalus* and *Prunus* species in Fars. The green larvae on *Pistacia mutica* were described under the symbol 17R and the grey larvae on the same tree under 17Q. The *Amygdalus* and *Prunus* larvae were smaller and distinct in appearance and resembled larvae of *Epithierina rhodopoleos* Wehrli which I was then rearing ex ovo; they were presumed to be all that species. In February 1942 the type of *Ep. pistaciae* mea hatched from a pupa labelled 17R and the type of *Ep. bahmana* mea from a pupa in a box of pupae marked 17Q. In late 1943 (*Journ. Bombay Nat. Hist. Soc.*, XLIV) my descriptions of *pistaciae* and *bahmana* were published, together with larval descriptions, originally made from 17R and 17Q respectively. In an earlier 1943 article "Early stages of Palearctic Lepidoptera V" (i.e. XLIII, part 4) I described the larva, reared from ova, of *Ep. rhodopoleos*, with a photograph of it.

In 1950 I again took larvae, but more numerous than in 1941, on the same trees and bushes in Fars. I marked pupae from grey geometrid larvae on *Pistacia mutica* 17Q and those from green geometrid larvae on the same tree, 17R, following my previous notes. I also however remarked that, when these two types were growing up in captivity, some small green larvae turned grey before reaching maturity; the pupae of such were labelled 17Q. In February 1951 these pupae hatched; only one species emerged from the 17Q and 17R pupae, *Ep. pistaciae*; eight examples of it hatched, four from 17Q and four from 17R. On the other hand, examples of *Ep. rhodopoleos* Wehrli, *Ep. bahmana* mea and *Ep. ghirshmani* mea hatched from the numerous, smaller, green geometrid larvae from various localities in Fars on *Amygdalus* and *Prunus* species.

It seems probable therefore that my original description of the larva of *Ep. bahmana* mea is really that of a green form of the larva of *Ep. pistaciae* mea; it is certain that the larva of *Ep. bahmana* mea feeds on various Rosaceae bushes and is very similar to that of *Ep. rhodopoleos* and *ghirshmani*. feeding on the same foodplants; probably it does not feed on *Pistacia* at all.

These observations not only necessitate the correction of the original description of *E. bahmana* early stages but reveal hitherto unknown details of the early stages of *E. ghirshmani* mea. It appears therefore that the genus *Epitherina*, like the closely-related genera *Theria* and *Bapta* (and probably also *Heterobapta*, which however I have not yet bred) is oligophagously attached to Rosaceae, especially *Prunus*, *Amygdalus*, and *Crataegus*, while *pistaciae* mea. at first wrongly placed in *Epitherina*, is monophagous on *Pistacia* and also generically distant; for its true genus, see my article "Middle East Lepidoptera X" appearing in this Bulletin on pages 187-210, this year.

*E. ghirshmani*, *bahmana*, *rhodopoleos* and *pistaciae* have all a similar phenology, being univoltine vernal; but *Heterobapta* is univoltine autumnal

#### ***Selidosema tamsi* Rebel (Plate, fig. 12).**

As I have already published elsewhere, all the *Selidosema* forms in Cyprus, even though, some resemble *S. brunnearia* subsp. *syriacaria* Stgr., are in fact Rebel's species.

The larva is grey-brown or plum-coloured red-brown, with longitudinal mottlings and a knotted head. The dorsal line is double, dark grey, variable in width. Setae, black. The sublateral lines are composed of grey pencilling. The spiracles are black-rimmed and placed above a wavy sublateral ridge usually paler. The tips of the head are whitish behind, blackish in front. Abdominal feet, grey-mottled.

Foodplant : *Poterium spinosum*. Feeds at night.

Larvae, full-grown on the coastal plain, near Kyrenia, in iii.47, pupated then and produced moths on 21.vi. and 17.vii.47. The moth is apparently univoltine.

#### **PYRALIDAE**

##### ***Sefidia persica* Amsel 1950.**

The larva is green or green dorsally infused with brown. The head and somite 1 are smaller than the other somites. In the browner form the dorsal line is red, yellowish-edged, with two whitish green lines on either side, on a brownish field. The spiracles are fine, black, ringed with whitish-green.

The larva lives in a silken shelter on the foodplant-twigg and eats the leaves in spring. The foodplant is wild senna (*Colutea* sp., probably *arborescens*). Larvae collected on 4.v.50 in the Pireh Zan oak woods, circa 7000

feet, pupated soon after in their larval shelter, and produced moths on 24, 25.v.50.

Biotope : woods and bushy hills of Fars, at 6000 feet and higher.

***Apyrausta persicalis* Amsel (1951).**

The larva, which tapers to head and tail, is pale green, virtually unmarked, slightly yellower and wrinkled on the somital joints, with short soft whitish hairs. The head and feet are green. Vague wavy paler green longitudinal lines are just discernible. Spiracles, very fine, dark. Occasionally a larva assumes a purplish black colour.

A larva which pupated on 1.vi.50 produced a moth on 15.vi.50. The moth is multivoltine but more numerous in early summer than at other seasons.

Foodplant : *Fraxinus*.

Biotope : gardens and woodlands of Fars at 5000 feet and higher. The larva often defoliates ash-trees; it lives between two ash-leaves bound together with thread.

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## Explanation of Plate

- Fig. 1 : *Amathes xanthographa* Schiff. larva (Shiraz, Persia).  
Fig. 2 : *Amathes pulverea* Hamps. larva (Shiraz, Persia).  
Fig. 3 : *Ocneria terebynthina* Stgr. larva (Fars, Persia).  
Fig. 4 : *Sidemna apothaina* Brandt larva (Shiraz, Persia).  
Fig. 5 : *Zygaena seitzii* Reiss larva (Shiraz mts., Persia).  
Fig. 6 : *Sterrhia mancipiata repagulata* Prout larva (Tehran, Persia).  
Fig. 7 : *Minucia bimaculata nigrimaculata* <sup>Wals.</sup> larva (Fars, Persia).  
Fig. 8 : *Clytie sancta* Stgr., half-grown larva (Cairo, Egypt).  
Fig. 9 : *Clytie sancta* Stgr., dark form larva (Cairo, Egypt).  
Fig. 10 : *Clytie sancta* Stgr., pale form larva (Cairo, Egypt).  
Fig. 11 : *Pericyma albidentaria* Freyer larva (Shiraz, Persia).  
Fig. 12 : *Selidosema tamsi* Rebel larva (Kyrenia, Cyprus).

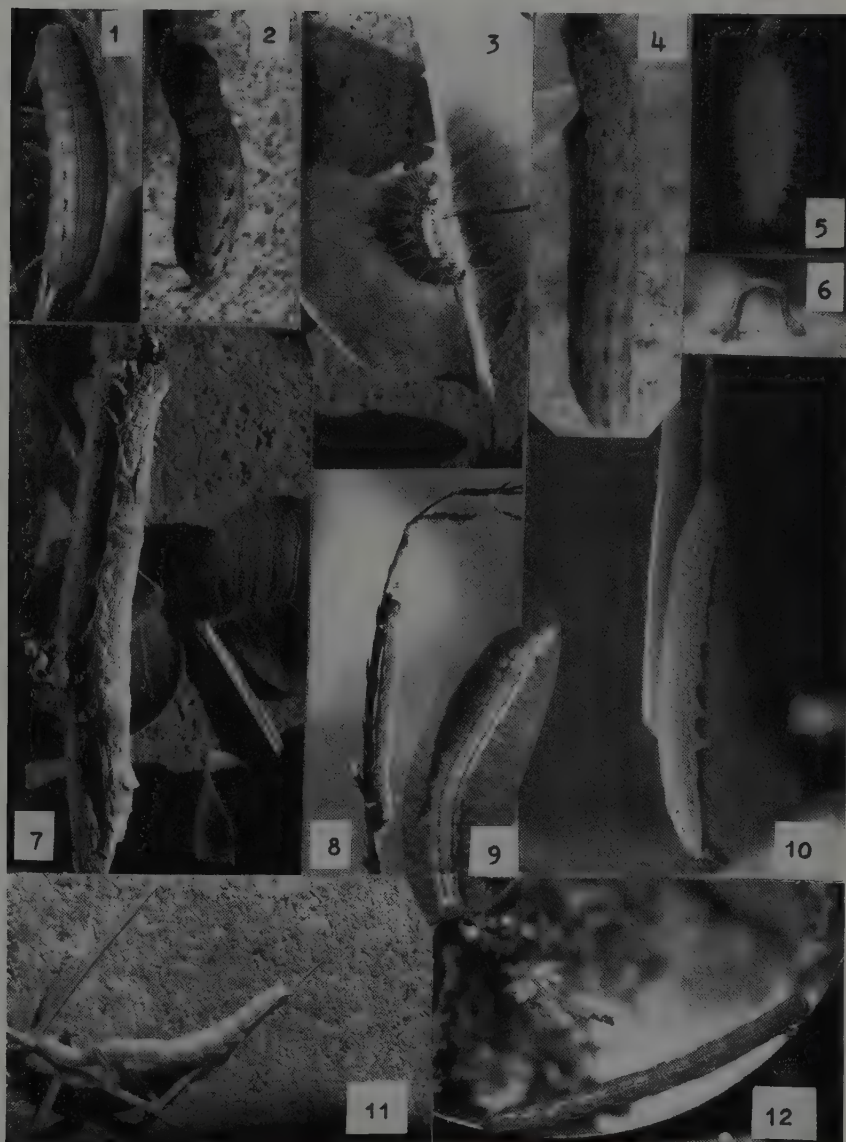
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*Early stages of Palearctic Lepidoptera, X*

E. P. Wiltshire

Plate





# Middle-East Lepidoptera, X/

## MORE NEW SPECIES AND FORMS FROM PERSIA (IRAN) AND SYRIA

(with 16 Text-Figures and 1 Plate)

by E.P. WILTSHIRE, F.R.E.S.

The immediately preceding article in this series, dealing with Lepidoptera from Arabia, Iraq and Persia, appeared in this Bulletin in 1949. The Persian material there described was taken by me during my first residence in Shiraz. Since September 1949 I have been fortunate to reside there again, and conditions have favoured further entomological exploration. I have studied the new material resulting from this on the spot and have found further novelties to science, which are introduced hereunder. I am indebted to Mr. D.R. Hay-Neave for certain specimens taken at Bushire, and to Mr. Arjumand for some from Darab. I also include mention of a hitherto undescribed form from North Persia, specimens of which, taken by Fred Brandt, are in the British Museum. An interesting new form from the Syrian desert is also described hereunder taken by Abdul Mun'im S. Talhouk.

I must acknowledge the invaluable assistance of Mr. W.H.T. Tams, Monsieur Charles Boursin and Mr. D.S. Fletcher; I am also grateful to Mr. C.L. Collenette, Herr Franz Daniel, Dr. Gustav de Lattin, Monsieur Charles Rungs, and M. Eugene Wehrli for aid and advice of various kinds.

In addition to the descriptions of the types, I also give below descriptions of the early stages of three of the new species, and some other taxonomic notes, notably some ne-alloype descriptions of little known species of which only one sex was previously known and in which sexual dimorphism occurs, in some cases to a marked degree.

### LEMONIIDAE

#### *Lemonia peilei talhouki* subsp. n.

Fore-wing, strikingly different from the Iraqi and Persian forms, bleached whitish up to the brown proximal edge of the post-median fascia;

a small brown discal spot appears in the middle of this whitish area. Hind-wing and under-side of both wings, as in the typical form. The two forms already named, namely *peilei* Roths. (from Eastern Iraq and Western Persia) and *farsica* Wilts. (from South-West and Central Persia), both have the fore-wing upper-side ground-colour some shade of brown, and the bleaching of the greater part of the fore-wing upper-side in this new form is undoubtedly a reaction to the more arid desert conditions of the locality; there are similar cases of bleaching, especially in the Lasiocampidae, from the Syrian and Arabian deserts, and the Eastern desert in Egypt, usually affecting the whole fore-wing, not only part.

Span : 40 mm.

Holo-Type : ♂, 14.xi.50, Deir-ez-Zor, Syria (leg. Abdul Mun'im S. Talhouk, Department of Entomological Research, Ministry of Agriculture, Damascus, Syria). This male is in my collection, but other examples are in collection Talhouk and collection Department of Entomological Research, Damascus.

#### LASIOCAMPIDAE

##### *Chondrostega darius* sp. n. (Plate, figs. 1, 2 and 3)

At first glance this new species can be distinguished from all congeners, and also shares with the *Lemonia* form just described its general colour-scheme, that is, the fore-wing in its basal half is bleached whitish, but is brown in the distal half. It comes in the *aurivillii-fasciana* group.

The fore-femur, twice as thick as that of *feisali* Wilts. and *fasciana* Stgr. (of which latter I have examined an example from Palestine ex coll. Petroff) makes it impossible to consider this new form a race conspecific with those two, despite the superficial similarity of larva of *darius* and of *feisali*. The description which I gave in *Entomological Record* (March 1946, p. 28) and photograph of the larva of *feisali* fit the *darius* larva well enough. The wingless female of *darius* also resembles that of *feisali* there described but it should be noted that, in the *darius* female, the thorax is brownish coloured, whereas in the male it is whiter.

The male fore-wing is satiny-whitish in the basal half but a chocolate-brown suffusion covers the distal half and also the base of the costa. In one specimen, shown in fig. 3 of the Plate, the subterminal area is slightly paler and the fringes are chequered but in all the others the fringes and subterminal area are unicolorous brown.

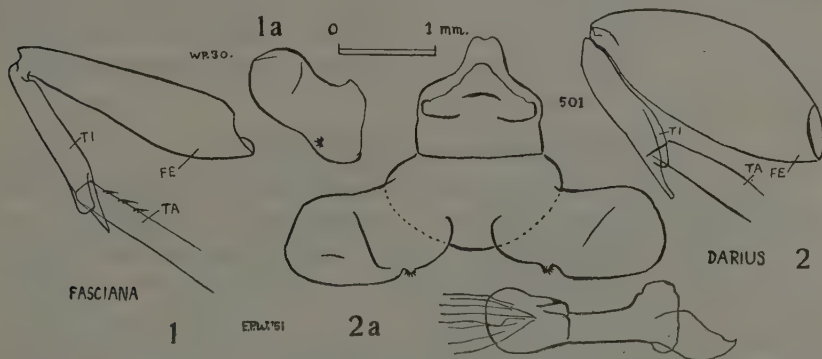
Text-figures 1 and 2 show the foreleg and male genitalia of the new species and *fasciana* Stgr.

Span (♂) : 31-35 mm.

Holo-Type (♂) : 30.ix.50, c. 6000 ft., hilly steppe, c. 5500 ft Shiraz, Persia (in my collection).

Allo-Type (♀) : hatched 9.ix.50, from larva found feeding on low herbs, hilly steppe, Fars, Persia (in my collection).

Para-Types : 5 ♂♂, 30.ix.50 and 2.x.50, 5000-6000 ft., hilly steppe, Shiraz, and hatched 13.x.50, from larva, Fars, same situation as allo-type (in my collection).



Figs. 1 and 1a : ♂ Fore-leg and left valve of *Chondrostega fasciana* Stgr. (Palestine; leg. Petroff). — Figs. 2 and 2a : ♂ Fore-leg and genitalia (ventral open position, with aedeagus separated) of *Chondrostega darius* sp. n. (TI = tibia, TA = tarsus, FE = femur).

Nota-Bene : In previous articles, on account of the larval similarity, I wrongly identified the Shiraz *Chondrostega* with the species found at Ahwaz, Khuzistan, i.e. *C. fasciana feisali* Wilts., but now having for the first time taken a series of males I realise that this was wrong and that both in colouring and structure the « Gurbah-i-Noruz » caterpillars are distinct.

#### *Trichiura sapor* Wilts. 1946 (Plate, fig. 7)

♂, stronger-marked than the ♀, the pale-grey fore-wing having a clear dark-grey median area defined by blackish fasciae and the fringes chequered.

Fore-wing, pale grey; ante-median fascia, as in *T. crataegi* L.; median area, clouded with bluish grey in the cell, becoming whitish-grey towards the hind-margin. Nervures marked with black in the median area and also more sparsely scaled with black beyond it. A heavy black wedge-shaped mark in the cell. Post-median fascia, more rounded on the radial and median nervures, and proceeding straighter from the cell to the hind-margin than in *T. crataegi* L. and *ilicis* Ramb. in both of which this fascia is conspicuously angled on nervure 2; this angle is quite absent in *T. sapor*. The post-median fascia becomes obsolete towards the hind-margin. Fringes, chequered with black between the nervures.



Hind-wing, whitish grey, unmarked, except for the fringes, which are chequered but less strongly than on the fore-wing.

Abdomen, grey.

Length of fore-wing, 14 mm.; span, 29 mm.

Ne-allo-Type: ♂, hatched 16.xi.50, from a larva found on *Amygdalus spartioides* on 1.v.50 at Sarvistan, c. 6000 feet, Fars, Persia (in my collection).

Figure 8 of the Plate shows a second female, taken to light at Hunai-fagan, c. 5500 feet, Fars (about 50 miles south of Shiraz) on 19.ju.49; this had a span of 33 mm. and was smokier grey than the holo-type female described in my 1946 article (ut supra).

***Trichiura pistaciae* sp. n. (Plate, fig. 4)**

This interesting new species may be placed after *T. ilicis* Rambur from Spain. Its male genitalia show that it is congeneric with but distinct from all hitherto known *Trichiura* species. They are shown in the Plate, fig. 11.

In neuration it differs slightly from the foregoing congener, *T. sapor*; whereas in *T. sapor* hind-wing nervures 7 and 8 are connate before the disco-cellular, in *T. pistaciae* nervures 6 and 7 are connate after the origin of 8, and at the disco-cellular; moreover, whereas in *sapor* hind-wing, nervures 4 and 5 are connate at the disco-cellular, with 3 originating before this point, in *T. pistaciae* nervures 3, 4 and 5 are connate at the disco-cellular, with only nervure 2 originating before this point.

Palp, head thorax and legs are profusely clad with thick hairs. The male antenna is bipectinate (plumose) to the tip. The tongue is absent. Eye, hairy. Frons, with a small truncate cone. Abdomen clad with fine long hairs laterally and ventrally but almost bald dorsally until terminal segments which are hairier.

The pupa differs from that of *T. sapor* in the anal armature; there are many hooks arranged in three rows close together one above the other. The phenology is as in other *Trichiura* species and the larva feeds on trees.

Hair of feet, head and thorax of this new species, ochreous mixed with dark grey and blackish, appearing dark grey. Abdominal hairs, paler.

Fore-wing, pale ochreous, heavily powdered with grey and black. The ground-colour appears only in two narrow bands, one just before the ante-median fascia, the other just after the post-median fascia, and extending in streaks for a short distance along the costa from the latter and to a lesser extent along the principal nervures beyond the median area. The median area is fairly narrow, and regular, being bounded by the two fasciae just mentioned. Their course is as follows: ante-median, from a point on the costa about 4 mm. from base to one on the hind-margin about 3 mm. from base, bent gently outwards on the radial; post-median, from a point on the

costa 7 mm. from the base to one on the hind-margin about 5 mm. from base, at first at right angles to the costa, then strongly but obtusely bent on the radial. Submarginal line, wavy, irregular, obsolescent, disappearing in a dark grey apical suffusion. Termen, a series of black spots joined by a fine line. Fringes, pale ochreous, chequered with black.

Hind-wing, paler and less marked; fringes as on fore-wing.

Under-sides, fore-wing, less banded than upper-side, almost uniformly grey-suffused; hind-wing, only slightly paler. Fringes, both wings, chequered.

Male genitalia (see Plate, fig. 11).

Span : 28 mm.

Holo-Type (♂) : hatched 6.xi.50, from larvae beaten from *Pistacia mutica* trees in « bann » park-woods c. 6500 feet Muk Pass (45 miles south of Shiraz), Fars, South-west Persia (in my collection).

The larva at first glance recalls a « lappet-caterpillar » (e.g. *Pachypasa*, *Epicnaptera*), though smaller. It is pale grey, with oblique black dorsal marks on the abdominal segments, almost forming dorsal V-marks pointing backwards. Somites 4 and 11 are heavily black-marked. There are short black dorsal hairs and long whitish lateral hairs. Spiracles, inconspicuous.

The cocoon is oval and papery, c. 20 mm. long. The pupa is described above.

#### ***Eriogaster amygdali* Wilts. (Plate, fig. 9)**

(*Journal Bombay Natur. Hist. Soc.*, No. 3, 1941)

The female differs from the male in being of a dull purplish brown, not pale yellow-brown, hue; it has the pure white cell-spot of the male; its markings are similar; it is larger; its antennae are dull-brown, white-scaled on the shaft, with shorter bi-pectination; it has a large silvery-grey anal tuft.

Span : 41 mm.

Ne-allo-Type (♀), and another ♀ : 9.ix.50, c. 6500 feet, Sineh-Safid, Fars, Persia (in my collection). The ne-allo-type was taken flying near the bushes of the foodplant, *Amygdalus eburnea*. At a lower elevation the species also feeds on *Amygdalus horrida*. The second female was found actually ovipositing on *A. eburnea*. The ova are laid in spiral formation along twigs soon after night-fall and covered with hairs from the anal tuft. The female vibrates its wings while laying but clings tenaciously to the twig when taken. The early stages were described in the original description (made from two males in 1941) and a photo of the larva was given in *Journ. Bombay Natur. Hist. Soc.*, 43, No. 4, 1943, Plate I, fig. 12.

## AGROTIDÆ (PHALÆNIDÆ)

*Evisa reisseri* sp. n. (Plate, fig. 25)

I introduce this new species in the genus *Evisa* Reisser, despite the somewhat different hair-cover on the thorax, and do so on account of the spineless tibiae, the normal fore-tarsi, the absence of frontal prominence, the smooth eyes without lashes, the short palpi, the well-developed tongue and the ciliate antennae. The male genitalia shown in Fig. 3 also are not far from those of *Evisa schawerdae* (as illustrated in Boursin XXVII (1940): *Mém. Mus. Nat. Hist. Nat.*, Tome XIII, fasc. 4, Pl. X, fig. 22) and Boursin agrees that it belongs in this genus. It is the second known species therein. Boursin's remarks on the position of this genus in the *Cuculliniæ* should be noted (Boursin (1940), XXIII: *Mitt. der Münchner Ent. Ges. e.V.*, XXX J, heft II, p. 509).

The fore-wing is more pointed than in *Evisa schawerdae* Reisser. The species is named after Herr Hans Reisser, of Vienna, who discovered the genotype and has also assisted me greatly with various problems.

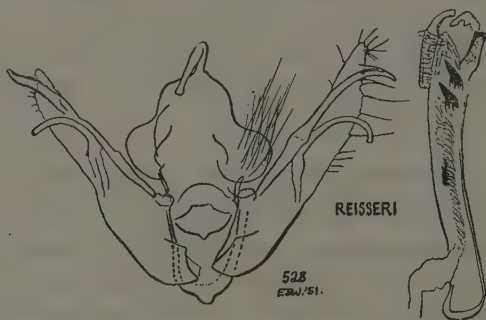


Fig. 3 : *Evisa reisseri* sp. n., ♂ genitalia (ventral open position with aedeagus separated). The juxta has been cut in preparation, and is longer than in the drawing.

♂, frons, black, hairless; a bristly hair-tuft projects forward at the top; antenna, ciliated; top of head with short hairs; palp, short, the third segment very short, porrect, smooth, the second segment with longer scales and hairs adpressed.

Thorax, with adpressed scales, ochreous mixed with black; similar scales are also present on first abdominal segment.

Fore-wing, buff, heavily mixed with grey-brown and black scales, especially grey-suffused on the costa sub-apically and also sub-terminally; a fine black basal streak; orbicular and reniform stigmata black-outlined, the former small, round with dark central dot, the latter larger, kidney-shaped, paler distally, darkened in the lower lobe; all fasciae obsolete, but there

are vague traces of a pale submarginal dentate line containing black streaks. Termen, wavy, clearly-defined in black proximally, and paler ochreous distally. Fringes, dark grey.

Hind-wing, dirty grey, darker terminad, with traces of a post-median fascia, and nervures slightly darkened; termen, as on fore-wing; fringes, dirty grey.

Under-side, fore-wing, greyish, paler proximally, with reniform stigma marked in grey and a fuscous sub-apical, apical, and marginal suffusion between nervures 3 and 7.

Span : 30 mm.

Holo-Type (♂) : 2.xi.50, Hunaifagan, 5500 feet, lower slopes of mountains on east side of Khajei plain, about 50 miles south of Shiraz (Pistacietum-Amygdaletum-Crataegetum), Fars, S.-W. Persia (in my collection).

Flies together with *Pfeifferella gracilis* Wagner and can be distinguished therefrom by its paler more ochreous coloration, and by the male antennae which in *gracilis* are bipectinate.

***Agrochola disrupta* sp. n. (Plate, figs. 22 and 23)**

This striking new species occupies a rather special position in the genus *Agrochola* (= *Amathes* auctorum) and perhaps merits the creation of a new genus or sub-genus. The markings suggest a relationship with *egorovi* Bang-Haas.

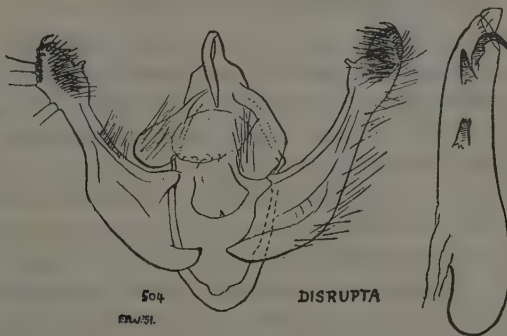


Fig. 4 : *Agrochola disrupta* sp.n., ♂ genitalia (ventral open position with aedeagus separated).

Palp, second segment with long black hairs below and more numerous shorter grey hairs. Third segment, short, porrect. Frons, slightly bulging, hairless, covered with yellow-brown scales, less granular than the frons of *Derthisa*.

Tongue, rather short, thinner than in *Agrochola lychnidis* F. or *oropotamica* mea. Male antenna, ciliated. Eye, with black lashes, rather scantier than those of *A. lychnidis* F.

Fore-wing, with apex truncate, forming two obtuse angles, at nervures 8 and 9; the outer margin is at an angle of about 60 degrees to costa until nervure 3, then drawn in further, giving the fore-wing a narrow pointed aspect. Ground colour, pale ochreous grey, marked with a striking black disruptive band from the costa. Many other Middle East species (e.g. *Dichagyris singularis* Koll., *Caradrina eremocosma* Boursin or *Agrochola egorovi* B.-H.) have a pattern with the same disruptive effect but this new species differs from them all in that the black band is at right angles to the costa and continues straight almost across the fore-wing, and begins exactly in the centre of the costa, that is, it represents the median shade, not the ante-median or post-median fascia.

Span: 31-34 mm.

The male genitalia (fig. 4) are also distinctive; both harpe and ampulla are absent; the corona is strong; there is a small digitus on the costa; the uncus is normal; the aedeagus contains three cornuti of moderate size, of which the most proximal is truncate with three points, and the most distal is sickle-shaped.

Holo-Type and Para-Type: 2 ♂♂, 4x.50, to light, Pireh-Zan oak-woods, 7000 feet, Fars, South-west Persia (in my collection).

#### ***Sidemia scrophulariae* sp. n. (Plate, fig. 19)**

This new species is very similar in aspect to *Sidemia hedygramma* Brandt 1943 and *Sidemia gracilis* Brandt 1943 both from South Persia. Its purer grey ground-colour, rather earlier season of flight, and male genitalia distinguish it. The genitalia show a close relationship to *Sidemia apothaina* Brandt 1938, and the two other *Sidemia* species mentioned above, but none to *Sidemia beduina* Wilts. 1949 and *Sidemia discordans* Boursin.

Palp, grey, laterally blackish; last segment, very short. Second segment of palp, as long as diameter of eye. Tongue, rather short; frons, smooth. Eye, with lashes. Male antenna, ciliated. Tibiae, spineless. Fore-wing, of a grey ground-colour similar to that of *Antitype canescens* Dup. or *Crymodes bischoffii zagrobia* Wilts. Median area, darker grey. Orbicular stigma, a small whitish circle. Reniform stigma, a white crescent. Markings, very like *hedygramma* Brandt. Fringes, chequered, grey and white. Hind-wing, pale grey; fringes, paler. Compared with *apothaina* Brandt, the markings are much vaguer, fewer, and fainter, and the median area narrower, the ground-colour is purer grey.

Span: 37 mm.



The male genitalia which are illustrated in fig. 5 have a moderately-developed corona, beginning at the costal apex, with harpe projecting on the ventral side; the harpe is similarly placed in *apotheina* also, whereas in *hedygramma*, when the valves are mounted in the conventional position, shewn in the text-figures, the harpe projects above the corona. In *Sidemia gracilis* the harpe projects ventrally in a longer, more slender hook. In the aedeagus of *scrophulariae* there are three moderate-sized but sharp cornuti situated distally from a field of fine spines; the aedeagus is somewhat sclerotised both above and below the distal orifice. In *apotheina*, however,

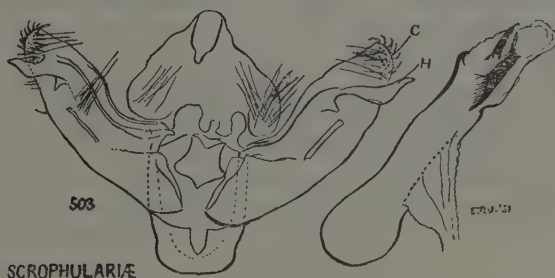


Fig. 5 : *Sidemia scrophulariae* sp.n., ♂ genitalia (ventral open position, with aedeagus separated). C. Corona ; H. harpe

there are only two blunt cornuti, and the distal ventral end of the aedeagus is more heavily sclerotised and distinctly scobinated; in both *apotheina* and *hedygramma* the costal apex of the valve is separated from the corona by a concavity; the sacculus of the valve of *apotheina* is more sclerotised than in *scrophulariae* and extends further. The juxta is of much the same form in *apotheina* and *scrophulariae*, whereas in *hedygramma* it is longer and narrower; in *gracilis* it is proportionately smaller than the other three.

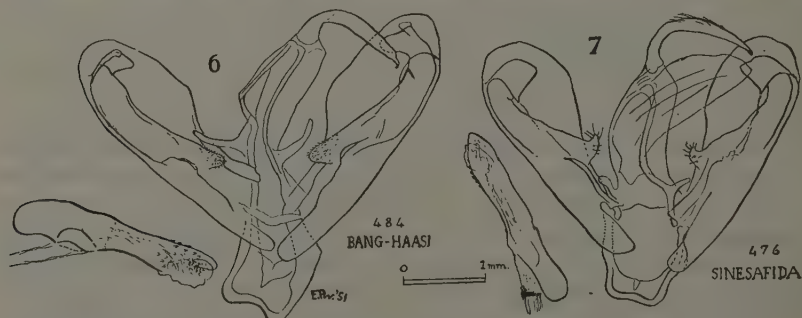
Holo-type and two Para-Types: three ♂♂, hatched from pupae on 14, 15.xi.50. The two earlier ones, para-types, spoilt themselves. The larvae had been found in April 1950 on flowers of *Scrophularia variegata* Bieb. (kindly determined by the Botanical Section, British Museum) growing on vertical cliff-faces in Tang-Ab gorge near Firuzabad, circa 4250 feet Fars, South-west Persia; on the same foodplant were found in 1941 the larvae which produced the only known specimen of *Cuculia faucicola* Wilts. 1943, but these were not found again in 1950; the search for them yielded a different new species, just described.

The larva, of which a photograph appears on Plate, fig. 21, is olive-grey with a whitish grey dorsal-line edged with blackish on the posterior half of each somite; the black edging converges to form a narrow V on each somite, interrupting the dorsal line. Sublateral area, paler; dorsal and

lateral areas, olive-mottled. Spiracles, black-rimmed. Setae, black, whitish-circled, Subdorsal lines, less darkly marked, grey, double, interrupted. In the last instar the head is yellow-brown, with black ocelli. The pupal diapause of seven moths is spent in a neat earthen cocoon, on the surface of the soil.

***Autophila sinesafida* sp. n. (Plate, fig. 20)**

This new species resembles a washed-out specimen of *Autophila bang-haasi* Boursin 1940 (Plate, fig. 34) but both in season of flight and in male genitalia it differs decisively. Whereas *A. bang-haasi* is an early summer to mid-summer species, *sinesafida* is extremely vernal, appearing with the willow catkins. Possibly there is a second generation in autumn, but I have not seen one, though I collected on its habitat throughout the year. The ground-colour is pale straw, and the markings are of a dull grey-brown colour. It is less strongly-marked than *luxuriosa* Zerny 1933 ssp. *garmstra* Wilt. described below, which also flies at an early season but at a lower elevation in Fars, and the fore-wing in particular lacks the dark submarginal



Figs. 6 and 7 : ♂ genitalia (ventral open position, with aedeagus separated) of (6) *Autophila bang-haasi* Boursin and (7) *A. sinesafida* sp.n.

wedges typical of *luxuriosa*; instead, the submarginal area is uniformly dark, and the rest of the wing paler. The postmedian fascia is obsolete, but a longer series is necessary to shew whether this is a good character; very likely the strength of its delineation varies. The cell-spot is strongly marked.

Span : 39 mm.

A more detailed description of the facies is not necessary for in this genus there are several species separable by genitalia only; reference should be made to the Plate and to the figure of the male genitalia (fig. 7). These suggest that the species is most closely related with *A. subfusca* Chr., a species illustrated on the same plate (fig. 31) and quite distinctive in aspect. The male genitalia of *A. subfusca* were illustrated in Boursin XLIII

(1947) (*Zeits. Wiener Ent. Ges.*, XXX, Pl. 10, fig. 11). The same work showed genitalia of the *Autophila* species superficially resembling *bang-haasi* and *sinesafida*. I give herewith (in fig. 6) an illustration of the genitalia of *A. bang-haasi* for comparison, for that species is rather similar to *sinesafida* in aspect, and the genitalia have not, to my knowledge, been published yet. The uncus of *sinesafida* is more regular; the lateral appendages of the tegumen are much shorter; the eeditum is very characteristic, being less densely setose than in *bang-haasi*, and retrorse at the peak towards the valve-tip; the harpe of *bang-haasi* is anvil-shaped, whereas that of *sinesafida* is ribbon-like and more rectangular; the aedeagus has a slenderer bulb.

Holo-Type ( $\sigma$ ): 10.iv.50, c. 6500 feet, Sineh Safid, Fars (in my collection).

***Autophila subfusca clara* subsp. n. (Plate, fig. 32)**

This race differs from the typical (in Turkestan and South-East Persia) by its paler straw ground-colour, far less suffused with smoky grey. In some cases the median area is concolorous, in others it is grey-suffused. The fore-wing fringes can be pure straw-yellow or chequered with grey-brown.

Span: 36-39 mm.

An extreme form of the new race *clara* is *obsoleta* ab. n. in which the fore-wing fasciae are obsolete (Plate, fig. 33).

The genitalia of the new race agree with those of typical *subfusca* Chr. as illustrated by Boursin (1947).

Holo-Types, both of *clara* and ab. *obsoleta* ( $\sigma\sigma$ ), 14.v.50, rocky steppe near West shores of Salt Lake, 5000 feet, Shiraz, Persia (in my collection).

Allo-Type ( $\varphi$ ) of *clara*: 15.v.50 (leg. Arjmand), mountains near Darab, c. 4000 feet, Fars, south-east of Shiraz (in my collection).

Para-Types of *clara*: 7 examples, same date and place as allotype, also one male, Dasht-i-Barm, 4000 feet (Shiraz-Bushire road), semi-deforested hills and plain, Fars, South-west Persia (in my collection).

Nota Bene: From Darab I also received two typical *subfusca* (Plate, fig. 31) taken flying together with the prevailing *clara*. It appears probable therefore that, proceeding south-eastwards from Shiraz and approaching South-east Persia where typical *subfusca* flies, the percentage of f. *clara* to typical *subfusca* gradually diminishes: in other words, *clara* and *subfusca* are probably extreme forms of a cline in South Persia.

***Autophila luxuriosa garmsira* subsp. n. (Plate, fig. 35).**

Over most of Persia the form *elbursica* Boursin 1940 (= *nigromarginata* Schwing.) (Plate, fig. 36) represents this species, e.g. not only the Elburz Mountains but also the high Yezd mountains; but in the "garm-sir" (win-

ter pastures) in Fars (the warmer, lower elevations) a form occurs which is distinct, and in the higher elevations of Fars the species has not yet been taken. Its paler straw colouring, unicolorous straw fringes, and obsolescent fore-wing markings distinguish this form from others of the species. In particular, the marginal field is less dark, never black-marked, its colour being dull grey-bronze. Its genitalia, known to me in only one sex, however agree with the *elbursica* forms and also of the *luxuriosa* race from Cyprus.

Span: 39 mm.

Holo-Type (♀): 26.ii.50, 4000 feet, Darab plain, Fars (in my collection).

Para-Type (♀): 9.i.41, 3000 ft., Tang-i-Chugan, Shapur, near Kazerun, Fars (in my collection).

It may be noted that this form resembles, but flies about three months earlier than, the *subfusca clara* forms, described above, inhabiting almost the same district; the genitalia differ as follows: the ostium is particularly different, the button being less sclerotised and the genital plate or sclerotisation of the venter is less circular, more oblong. The difference in the male armature is even more striking but no males have yet been taken of the *garmsira* race, of *luxuriosa*. This new race also flies four or five months earlier in the year than the high mountain races of the same species, such as *elbursica*.

#### **Caradrina (Paradrina) zandi sp. n. (Plate, figs. 18 and 19)**

This new species comes next to *scotoptera* Pung. and *jacobsi* Roths.

♂ antenna, with short ciliation; ♀ antenna, simple.

♂ ♀; Palp, ochreous grey, with intensely black lateral scales on second segment.

Head, thorax and abdomen, ochreous grey, peppered with black.

Fore-wing, ochreous very heavily freckled with many darker grey and some black scales, appearing mousy-grey; marked with darker grey cross-lines or fasciae, proceeding from blackish costal marks. Basal fascia, usually obsolete. Ante-median fascia, at right angles to costa, proceeding almost straight to hind-margin, and reaching it at 1/3. Median shade proceeding obliquely from a costal spot above the orbicular stigma to the reniform stigma, thence bent to proceed to hind-margin close to the ante-median fascia. Orbicular stigma, a vague dark grey spot, or obsolete. Reniform stigma, kidney-shaped, dark olive-grey, with an ochreous border; sometimes its lower lobe is much darker than the upper, and sometimes the stigma is more closely constricted in the middle. Postmedian fascia, denticulate, with a pale ochreous distal border, starting from a costal spot close to the reniform stigma, proceeding very obliquely and encircling the same stigma distally at a wide interval, and reaching the hind-margin at about 2/3. Submarginal

area, usually darker, especially near the apex. Submarginal line, pale ochreous, irregular, obsolete. Terminal line, dark, fine, faint, distally edged with pale ochreous. Fringes, brown-grey.

Hind-wing, whitish, fuscous terminad, with fuscous nervures. Termen, clearer-marked than on fore-wing; fringes, paler distally

Fore-wing under-side, suffused with fuscous, paler along the costa, the dark post-median fascia being represented by a fuscous band near the costa, otherwise unmarked; sometimes the under-side is paler, with fuscous dots on the termen, at end of nervures.

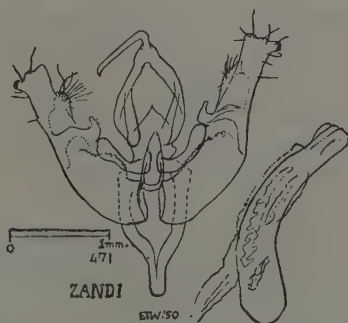


Fig. 8 : *Caradrina (Paradrina) zandi* sp.n., ♂ genitalia (ventral open position with aedeagus separated)

Hind-wing under-side, whiter than fore-wing, fuscous at the apex, sometimes with fuscous dots on termen at end of nervures.

Span : 25-27 mm.

The male genitalia are illustrated (fig. 8).

Holo-Type (♂) : bred ex-ovo, from an autumnal ♀, gardens, 5000 feet, hatched 20.iv.50, Shiraz, South-west Persia (in my collection).

Allo-Type (♀) : ditto, hatched 15.ii.50.

Para-Types : ♂♂ ♀♀, hatched 4.iii.50, 6.ii.50, 23.ii.50, 17.ii.50; also parent of above, ♀, 8.x.49, Shiraz gardens; and other ♂♀, 16.x.49, 8.x.49, 11.x.50, same locality, South-west Persia (in my collection and collection Boursin).

In addition to the above types which I have seen, Monsieur Charles Boursin informs me that he has examples of the same species from Palestine, Egypt and Anatolia; he has compared these with an example from Shiraz which I sent him, and has sent me a microphotograph of the genitalia of an Egyptian example ex collection Alfieri. I therefore designate these specimens in collections Boursin and Alfieri as further para-types.



According to Monsieur Boursin, the new species is very close to *C. jacobsi* Roths., from Algeria and Tripolitania, but this is a blackish species. The group in which *zandi*, *jacobsi*, and *scotoptera* Pung., come, is characterised by the bunch of black scales on the ventral prong of the valve-tip and also by the ante-apical swelling of the valve-costa, usually with a tuft of hairs. Other relatives in the same group, according to Boursin, inhabit Abyssinia, and he inclines to consider the group of Ethiopian origin; *C. katherina* Wilts. 1947 also comes in this group.

Having bred the new species *C. zandi* ex-ovo I can give below a description of its early stages :

The freshly laid egg is pure white. Later it turns slightly greyish. Later still, a purplish apical dot and ring develop. The egg hatches in eight days.

The freshly-hatched larva is pale grey with fine black setae and two fine black points at the upper edge of the head.

The half-grown larva, observed on 10.xi.49, had a blackish head much smaller than the body-diameter; the larva is fat and tapers to the head, being grey-brown in colour. The dorsal and subdorsal lines are whitish with dark edges vague and interrupted. On the posterior edge of each somite the dorsal line narrows and the edges meet. The setae are still black but now less conspicuous. The hairs are pale, and inconspicuous. The spiracles are black.

The larvae did not alter much more in appearance as they grew. By December 8th most had made cocoons in the earth and pupated. It is not certain that the above rate of growth and dates of emergence are natural in a wild state. There may be two broods, a vernal and an autumnal, but I only caught the moth wild in October. The foodplants in captivity were *Taraxacum*, *Plantago*, *Calendula* and other low plants.

#### ***Herminia proxima anahita* subsp. n. (Plate, fig. 26)**

I have not yet examined a genuine *proxima* Chr. but Dr. Gustav De Lattin has kindly sent me a photo of the ♂ genitalia of Turkish *proxima* (from Marash) and I can detect no significant difference between these and my own preparation of *anahita*, which differs in being larger, and, to judge from the available descriptions of *proxima* and Seitz III, Suppt., Pl. 24, in having the outer border of the submarginal fascia hardly whitish and a wider submarginal field, especially on the hind-wing, where the fascia is more angled near the anal corner.

♂ antenna, bipectinate to tip (plumose), not swollen in the middle. Fore-leg, with ochreous hair-tuft.

Palp, third segment shorter than second but as long as diameter of eye.

Fore-wing and hind-wing, light grey marked with deep brown, or (f. *ochrea*) ochreous marked with light brown.

Fore-wing ante-median fascia and post-median, obsolete in f. *ochrea*, both, more or less running as in *crinalis*; reniform stigma, a brown crescent, other stigmata, absent. Sub-marginal fascia, wavy as in *proxima*, but outwardly edged with a paler grey or ochreous border of variable width, evanescent towards the costa. Termen, white, with a fine brown proximal border interrupted between the nervures. Fringe, brown or grey, darker proximally.

Hind-wing similar but without cell-spot, and the submarginal fascia does not reach costa; it is finely wavy and obtusely angled on nervure 2.

Span: 31-34 mm.

Holo-Type and Para-Type (the latter being the type of f. *ochrea* f. n.) both ♂♂, 1.vi.50, Qalat, c. 7000 feet, near Shiraz (mountain oasis: on wing at night in plantations), South-west Persia (in my collection).

#### LYMANTRIIDAE

##### *Lymantria daraba* sp. n. (Plate, figs. 12 and 13)

This new species appears to come between *L. destituta* Stgr. and *L. komarovi* Chr., differing from the former superficially only in hind-wing colour. The relationship of *destituta*, *komarovi*, *amabilis* Chr. and *lapidicola*



Figs. 9, 10 and 11: ♂ genitalia, right valve only, after detachment, interior lateral view, of (9) *Lymantria destituta* Stgr., (10) *Lymantria daraba* sp.n., and (11) *Lymantria amabilis* Chr. (C = cuiller.)

H.-S. will not be clear until the early stages of all are known. The markings and structure of these forms is not conclusive for a revision of the group, some other forms of which are also illustrated in the Plate, for comparison.

♂, head, antenna, thorax and fore-wing, like that of *destituta*, perhaps a shade darker-powdered.

Hind-wing, both sides, and abdomen, distinctly orange, but paler than in *amabilis* Chr. from Persia. Terminal border of hind-wing, powdery grey-brown, obsolescent in some, i.e. as in *destituta*, not deep black and clearly defined as in *amabilis* and *komarovi*.

Span: 40-43 mm., i.e. larger than *amabilis*.

Gentitalia (fig. 10), cuiller proportionately longer than that of *destituta*, otherwise very similar.

Holo-Type ♂, and 2 Para-Types ♂♂ : 14-15.v.50, leg. Arjuman, Darab, South-east Fars, 4000 feet, limestone mountains sparsely wooded with *Pistacia mutica*, *Amygdalus horrida*, *Zizyphus spina-christi*, etc., South-west Persia (in my collection).

Nota Bene : *L. destituta* f. *maraschi* Dan. (Plate, figs. 15 and 17) also flies at Darab and appears to have a longer season of flight there appearing earlier; it is widespread in Fars. *L. daraba*, on the other hand, has not been taken elsewhere in the province. *L. amabilis* (Plate, fig. 14) is widespread in Fars also. Figs. 9, 10 and 11, show the genitalia of these three forms, which probably all feed on the various wild species of *Amygdalus*; but I have so far only come across the larva of *amabilis* (see my description thereof (1943) in *Journ. Bombay Nat. Hist. Soc.*, Vol. XLIII, No. 4). *L. amabilis* is smaller than *L. komarovi* but the hindwing-markings suggest that these two may be conspecific.

#### GEOMETRIDAE

##### *Sterrhia sordida neavei* subsp. n. (= *microptera* Brandt nec Warren and R.)

At Bushire *Sterrhia sordida* Roths. flies together with typical *St. mimetes* Brandt. These two seem to be the only representatives in Persia of this group. The new race, described hereunder, is named after Mr. D.R. Hay-Neave, H.M. Vice-Consul, Bushire, who has collected most interesting material for me at Bushire; it is characteristic of the South Persian desert coast.

It differs from typical *sordida* by its clearer markings and from subsp. *nili* Wils. 1949 by its smokier grey, less pale and less ochreous ground-colour. It was figured in Brandt 1943 as *microptera*, but the structure of the true *microptera* was then unknown; see part II of my "Lepidoptera of the Kingdom of Egypt" (*Bull. Soc. Fouad Ier Ent.*, XXXIII, 1949) for the revision of this group.

Holo-Type (♂) : 23.iv.50, Bushire, Fars, in my collection.

Allo-Type (♀) : 9.v.50, Bushire, Fars, in my collection.

Para-Type (♀) : 22.iv.50, Bushire, Fars, South-west Persia, in my collection.

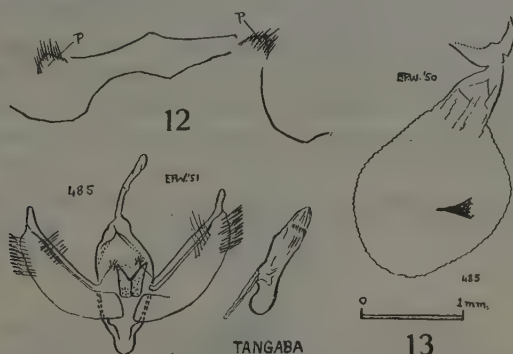
##### *Cidaria (Euphyia) tangaba* sp. n. (Plate, fig. 27)

Rather similar to *renodata* Pung. but the genitalia differ. It may be placed near that species.

♂ antenna, slightly ciliate; ♀ antenna, slightly pubescent.

Fore-wing, rather angular and narrow, with produced but rounded apex: with double areole; median area, whitish; rest of fore-wing, rosy grey. Lines, grey and black. Basal area, grey-suffused, bordered distally by a

strong convex black basal fascia; outside this is a rosy-grey area containing a faint brown fascia, and bordered distally by a double fine white fascia, followed by a black distal shade, constituting the ante-median fascia, running straight from the hind-margin at an outward angle of less than 90 degrees and bent on the cell to meet the costa at right-angles. The black shade is separated from the median area by a fine blackish parallel line. In the pale median area is a blackish elongated discal spot parallel to the costal portion of the ante-median fascia and close to that fascia. Postmedian fascia, irregular, outwardly angled sharply on the radial and more obtusely on the median nervure, composed of three parallel strands of unequal and variable intensity. Fine brownish lines, parallel to the post-median fascia, run through the submarginal field close to the fascia. Termen, a blackish line interrupted at the nervures.



Figs. 12 and 13 : *Cidaria (Euphyia) tangaba* sp. n.; (12) ♂ 8th sternite (P = coremata-lobes) and ♂ genitalia in ventral open position with aedeagus separated; (13) ♀ genitalia, ostium and bursa only.

Hind-wing, discocellular nervure with one angle only; freckly-grey with post-median fascia represented by three parallel wavy strands, the most proximal of which is heaviest black, becoming obsolete towards the costa, and separated from one another a paler whitish grey interior. Termen, as on fore-wing.

Under-side, dirty grey, with fasciae faintly marked.

Span : 25-28 mm.

♂ genitalia : Uncus, long, slightly spatulate. Transtilla, consists of two hairy papillae. Juxta, divided into two pointed arms, setose towards their base, where they are fused for nearly half their length. Saccus, oval. Costa of valve, produced in a short round-tipped club at apex. A strong tuft of hairs on membranous ventral extremity of valve. Aedeagus, without cornuti. Coremata-lobes on 8th sternite, very short, in form of papillae.

Both sexes genitalia are shewn in figs. 12 (♂) and 13 (♀).

Holo-Type ♀, and three ♀♀ Para-Types : 6.iv.50, Tang-Ab Gorge, near Firuzabad (c. 4000 feet), Fars, South-west Persia (in my collection and British Museum). This gorge is an ambiguous biotope, combining steppe mountain vegetation (e.g. *Pistacietum muticae*, *Amygdaletum spartioidis*, *Astragaletum fasciculifolii*, etc., with riverside vegetation, i.e. *Salicetum*, *Tamaricetum*, *Rubetum*).

Allo-Type (♂) : 2.ii.51, c. 3250 ft., Fahlian (Mamassani), Fars, South-west Persia (in my collection). Taken on rocky but treeless hill-side, dotted with dwarf bushes of *Astragalus fasciculifolius* sheltering *Calium* sp. 16

***Cidaria (Euphyia) rubidata bahrama* subsp. n. (Plate, fig. 30)**

This race quite lacks the rosy coloration of typical *rubidata* Schiff., from Europe. Moreover, it lacks the glossy smoothness of subsp. *fumata* Ev. from Altai, Uralsk, and East Turkestan); the median area is dirty whitish grey except for a dark narrow band bordering the proximal edge of the area. It is rougher and greyer in aspect than the two races just named. It also somewhat recalls *tangaba* sp. n. (above) which inhabits hotter country and flies earlier in the season; these two Fars forms are both given in the Plate figs. 27 and 30. The genitalia of *bahrama* agree with those of British *rubidata* but it should be noted that the figures in Pierce are inaccurate

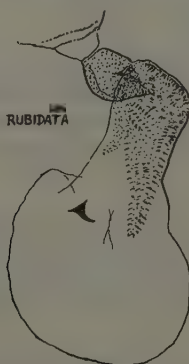


Fig. 14 : *Cidaria (Euphyia) rubidata bahrama* subsp. n., ♀ genitalia, ostium and bursa only.

and do not correspond to Pierce's slide of British *rubidata* in the British Museum. The ♀ signum is a single thorn (as illustrated in my fig. 14). not a scobinate disc, as in Pierce's book; the ♂ saccus is not pointed.

Span : 26-29 mm.

Holo-Type and Allo-Type (♂♀) : 1.vi.50, c. 7000 feet, Qalat gardens, near Shiraz, South-west Persia (in my collection).



Para-Types : 5 ♂ ♀, same date and locality, also 15.vi.50, c. 8000 ft., Kuh-Safidar, due south of Shiraz, South-West Persia (in my collection).

Also 4 examples, 30.v.40, Sineh Safid, c. 6000 ft., Fars, South-west Persia (in my collection and British Museum), and 1 example, 28.v.41, Pireh Zan, c. 7000 ft, Fars, South-west Persia (in my collection).

***Cidaria (Euphyia) rubidata elbursica* subsp. n.**

This race also lacks the rosy coloration of the typical; its solidly blackish fuscous central band distinguish it from subsp. *bahrama* mea (above) and *fumata* Ev. of which latter I have seen a series in the British Museum from East Turkestan. In all these *fumata* Ev., the blackish fuscous is reduced to a narrow band close to the ante-median fascia; a single Caucasus specimen of *rubidata* in the British Museum approaches the Elburz form as regards the median area, but the ground colour in this is whitish; another Caucasus specimen is rosy, approaching the typical European race. The rough greyish appearance of the Elburz form also distinguishes it from the more glossy brown ground-colour of *fumata* Ev., and the rough but more whitish-grey ground-colour of the Fars form *bahrama* mea, above.

Span : 28 mm.

Holo-Type (♂) : 4.ix.36, Keredj, North Persia, leg. Brandt, in British Museum.

Para-Type : 1 example, 25.v.36, ditto.

***Cidaria (Euphyia) rubidata hortulanaria* Stgr.**

*Cidaria hortulanaria* Stgr. has hitherto been placed as a form or synonym of *Euphyia basochesiata* Dup. but through the courtesy of Dr. E.M. Hering it has been possible to examine the type and it proves in fact to be conspecific with *rubidata* Schiff. Staudinger's name may be retained to denote the racial form with solid uniformly brown median band with weakly contrasting paler distal and proximal margins, and pale pinkish brown postmedian area. I am indebted to Mr. D.S. Fletcher for this fact and many other investigations.

***Cidaria (Coenotephia) apiciata pistacieti* subsp. n. (Plate, fig. 28)**

This rather striking form does not superficially seem very close to typical *apiciata* Stgr., of which there is a series of ♀ ♀ in the British Museum, determined by Bang-Haas as *apiciata* Stgr., from Askabad in Western Turkestan; it differs from those by the slightly bluish grey rather than brown coloration in the central band, the less clearly-marked underside postmedian-fascia, and the rather larger, broader wings. However, the ♀

genitalia of *pistaciati* and those *apiciata* are extremely close. The ♂ genitalia have not yet been compared, for lack of specimens of that sex.

Span : 32-36 mm.

Holo-Type (♀) : 2.xi.50, Hunaifagan (c. 5000 ft.), 50 miles south of Shiraz, Fars, Persia (in my collection).

Para-Types (♀ ♀) : 3.xi.50, Tang-Ab, c. 4500 ft., near Firuzabad, 60 miles south of Shiraz, Fars, Persia (in my collection).

The biotope in both these localities is a scrub woodland of *Pistacietum muticac* and *Amygdaletum spartiodes*.

***Epitherina rhodopoleos* Wehrli ♂ (Plate, fig. 29)**

(*Ent. Rundsch.*, LV, No. 31, pp. 354-355)

The morphology of the ♀ was even more fully given by Forbes in Wiltshire 1946 (*Proc. R. Ent. Soc.* (B), XV, parts 9-10) than in the original description. No male had been taken until 10.iv.50, when a male came to my light at Sineh-Safid, c. 6500 ft., Fars, South-west Persia; I designate this specimen the Ne-Allo-Type and describe it as follows :

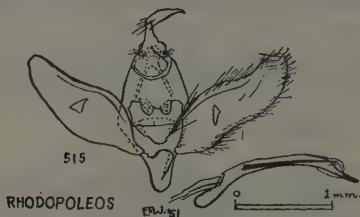


Fig. 15 : *Epitherina rhodopoleos* Wehrli, ♂ genitalia, in ventral open position with aedeagus separated.

It differs from the ♀ by its surprisingly larger size; the ♀ ♀ are 10 mm. smaller in span than the ne-allo-type (Span : 33 mm.). The antennae are ciliated to the tip with long fine cilia-bunches. In facies, though larger, the male agrees with Wehrli's description except that in my one example the ground colour is purer grey and the fringes are rather strikingly white-chequered. The species as a whole is not always easy to distinguish by facies from *Epitherina bahmana* mea, and for certainty the frons or the genitalia should be inspected. Curiously, on the night of capturing the ne-allo-type, no ♀ *rhodopoleos* was taken, but many ♀ ♀ *bahmana* came to light. The conical prominence on the frons however made the identity of the ne-allo-type certain, and the genitalia were also found to differ from those of *bahmana*, as follows.

The presence of a small harpe on the valvula at once distinguishes *rhodopoleos* (fig. 15) from the other members of the genus, of which the

genitalia were illustrated by Forbes, *loc. cit.* (1946). The *maeus* also differs, being thickened from its base to near its pointed tip. The aedeagus is rather similar to that of *Epitherina ghirshmani* mea but the fine long cornutus is only 2/3 of the length of the aedeagus the end of which, moreover, is strongly chitined and produced into a spine, in *rhodopoleos*. The juxta is also distinctive, being anchor-shaped; it has a few setae placed together on either side though they are not so fully developed or tuft-like as in *ghirshmani*. These differences are in my opinion of only specific worth and do not justify separating generically *ghirshmani* and *bahmana* from *rhodopoleos*. I have not, however, studied the other Baptine genera thoroughly.

***Rhoptria mardinata* (Stgr.) (= *Epitherina pistaciae* Wilts. 1943), syn. nov.**

In reply to my recent enquiry, enclosing a drawing of the ♂ genitalia of *E. pistaciae* mea 1943 (here reproduced in fig. 16), Dr. E. Wehrli has kindly confirmed my suspicion that this species is identical with *Pseudognophos mardinata* Stgr. of which he had preparations of genitalia of typical

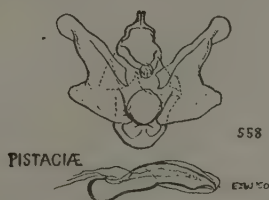


Fig. 16 : *Rhoptria mardinata* (Stgr.) (= *Epitherina pistaciae* mea 1943), ♂ genitalia, in ventral open position, with aedeagus separated.

specimens. I had not suspected this synonymy until I saw the recent plate in Seitz IV, Suppt.; the earlier Seitz plate (in Vol. IV) was quite misleading. In his unpublished manuscript of the text of Seitz IV, Suppt., Dr. Wehrli places this species in the genus *Rhoptria*, sinking *Pseudognophos* as a synonym thereof; it thus belongs to the subfamily *Semiothisinae*.

***Boarmia fredii* Wehrli 1943 (= *Scodionista astragali* mea 1949), syn. nov.**

In reply to a query, Dr. E. Wehrli has kindly informed me that my drawing of the genitalia of *astragali* is identical with his preparation of the type of *fredii*. The imagines cannot be distinguished superficially either. My name therefore sinks to his.

My 1949 description however is still worth looking at because it contains a description of the early stages of *fredii* with photo of larva and foodplant, and shows the genitalia.

Whether the name subgenus *Alcisca* Wehrli 1943 can stand is doubtful. The subgeneric name *Scodionista* Joannis, under which I described *astragali* in "Middle East Lepidoptera IX" (*Bull. Soc. Fouad I Ent.*, XXXIII, 1949, p. 369) is prior, and *Alcisca* appears to differ from it only in the loss of the tibial spine and frontal armature. In these days when genitalia are given greater importance than most other structures, my contention that *Scodionista amoritaria abdul-hamidi* Wiltshire, 1949 is congeneric with *astragali*, that is, *fredi*, should be noted, but until all the species of the former genus *Enconista* have been thoroughly investigated it is perhaps premature to condemn Dr. Wehrli's subgeneric name and I leave the question whether *Alcisca* = *Scodionista* open.

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# PLATE

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## Explanation of Plate

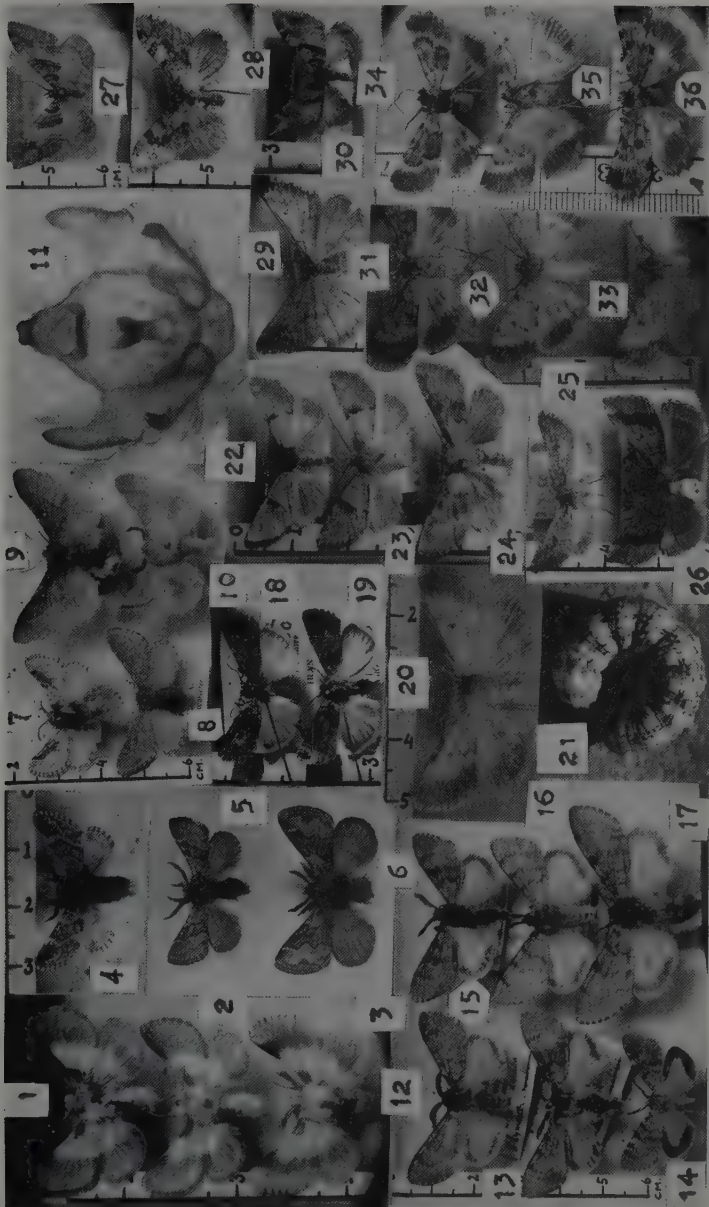
- Figs. 1, 2, 3 : *Chondrostege darius* sp.n., ♂♂ (South-west Persia).  
 Fig. 4 : *Trichiura pistaciae* sp.n., ♂ (South-west Persia).  
 Fig. 5 : *Trichiura ilicis* Rambur, ♂ (Spain).  
 Fig. 6 : *Trichiura crataegi* L., ♂ (Britain).  
 Figs. 7; 8 : *Trichiura sapor* Wilt. 1946, ♂ ♀ (South-west Persia).  
 Figs. 9, 10 : *Eriogaster amygdali* Wilt. 1941, ♀ ♂ (South-west Persia).  
 Fig. 11 : *Trichiura pistaciae* sp.n., ♂ genitalia, ventral view.  
 Figs. 12, 13 : *Lymantria davaba* sp.n., ♂♂ (South-west Persia).  
 Fig. 14 : *Lymantria amabilis* Chr. ♂ (South-west Persia).  
 Figs. 15, 16, 17 : *Lymantria destituta* Stgr. f. *maraschi* Dan., ♂♂ ♀ (South-west Persia).  
 Figs. 18, 19 : *Caradrina zandi* sp.n., ♂ ♀ (South-west Persia).  
 Fig. 20 : *Autophila sinesajida* sp.n., ♂ (South-west Persia).  
 Fig. 21 : *Sidemia scrophulariae* sp.n., larva (South-west Persia).  
 Fig. 22, 23 : *Agrochola disrupta* sp.n., ♂♂ (South-west Persia).  
 Fig. 24 : *Sidemia scrophulariae* sp.n., ♂ (South-west Persia).  
 Fig. 25 : *Evisa reisseri* sp.n., ♂ (South-west Persia).  
 Fig. 26 : *Herminia proxima anahita* subsp.n., ♂ (South-west Persia).  
 Fig. 27 : *Euphyia tangaba* sp.n., ♂ (South-west Persia).  
 Fig. 28 : *Coenoteophria apiciata pistacieti* subsp.n., ♀ (South-west Persia).  
 Fig. 29 : *Epitherina rhodopoleos* Wehrli., ♂ (South-west Persia).  
 Fig. 30 : *Euphyia rubidata bahama* subsp.n. (South-west Persia).  
 Fig. 31 : *Autophila subfusca* Chr., ♂ (South-west Persia).  
 Fig. 32 : *Autophila subfusca clara* subsp.n. (South-west Persia).  
 Fig. 33 : *Autophila subfusca clara obsoleta* ab.n. (South-west Persia).  
 Fig. 34 : *Autophila bang-haasi* Boursin (Central Persia).  
 Fig. 35 : *Autophila luxuriosa garmsina* subsp.n., ♀ (South-west Persia).  
 Fig. 36 : *Autophila luxuriosa elbursica* Boursin, ♀ (Central Persia).

(The figures in this Plate are not on the same scale, but a centimetre-scale appears against most specimens to show comparative sizes).

Middle East Lepidoptera, X

E. P. Wiltshire

Plate





# Studies on the biology of *Hyperaspis vinciguerrae* Capra,

WITH A FULL DESCRIPTION OF THE ANATOMY  
OF THE FOURTH STAGE LARVA

[ Coleoptera : Coccinellidae ]

(with 28 Text-Figures and 10 Tables)

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## I. INTRODUCTION

It is hardly necessary to emphasize the importance of the majority of Coccinellid beetles in the biological control of certain important insect pests. Their use for this purpose dates back to 1874, when *Coccinella undecimpunctata* L. was introduced from England into New Zealand in an attempt to control plant lice. Later in 1889, Riley introduced *Rodolia (Vedalia) cardinalis* Muls. from Australia into California, and this successfully subjugated the cottony cushion scale "*Icerya purchasi* Mask." in that country.

Since then, the study of the bionomics of these beneficial insects has received much attention by a number of workers notably, Palmer (1914), Clausen (1916), Simanton (1916), Hawkes (1920 and 1927), Cutright (1924), Fullaway (1924), Davidson (1927), Flanders (1930), Liu, Chi-Ying (1932), McKenzie (1932), Hecht (1936), Vesey-Fitzgerald (1938 and 1940), De Fluiter (1939), Kapur (1942 and 1944), Bodenheimer (1943), and Moursi and Kamal (1946).

As a contribution to our knowledge of predatory Coccinellids, and also owing to the fact that none of them has been thoroughly worked out in Egypt, a study of the biology and morphology of *Hyperaspis vinciguerrae* Capra, a common Coccinellid in this country, has been undertaken in the Department of Entomology, Faculty of Science, Fouad I University, Cairo. This paper deals with the general biology of the insect and the morphology of the pupa and the larval instars. Of the latter, the fourth instar is described in more detail.

This Coccinellid beetle is predaceous, feeding actively during both its larval and adult stages on mealy bugs in Egypt. It is commonly found in great numbers on the "Lebbek" and *Acacia* plants associated with mealybugs on which they prey. They are most abundant from May to December.

In his breeding experiments, Hall (1921) collected from plants highly infested with the Hibiscus mealy-bug "*Phenacoccus hirsutus* Green", large numbers of *Hyperaspis vinciguerrae* Capra (recorded as *Oxynychus erythrocephalus* F.), together with 54 other predaceous and parasitic insects natural to Egypt. This mealy-bug is a pest which was first introduced to Egypt in 1915. It soon spread out and during 1918 and 1919 it caused great devastation to ornamental trees and shrubs (Willcocks 1937). This author pointed out that, very little or nothing at all is known about the habits of the species recorded by Hall (1921), and about their exact relation to their host.

The general biology of the present species was mainly studied under laboratory conditions. It is hoped in the near future to study the biology under field conditions.

The authors are greatly indebted to Professor H.C. Efflatoun Bey, Dean of the Faculty of Science (Fouad I University) and Head of the Department of Entomology, for his constant help and unfailing encouragement. The junior author's best thanks are due to Dr. A.A. Moursi, Section of plant parasitology, Ministry of Agriculture, and Mr. A. Alfieri, Secretary General. Fouad I Entomological Society, for their valuable assistance. Thanks are also due to Mr. Balfour-Browne of the British Museum (Natural History) for kindly identifying the species.



## II. MATERIAL AND TECHNIQUE

The insects used in the course of the present work were brought fresh from the field, and were reared in the laboratory. Sets of glass vials were prepared. Each vial (2 x 8 cms.) contained sufficient food which consisted of Lebbek mealy-bugs and Hibiscus mealy-bugs. It was covered by a small piece of organdie which was tightly held round the mouth by means of a rubber band.

One of these sets contained adults taken immediately after emergence. In each vial, there was a male and a female. The food was changed every three days. Another set contained eggs, a third contained larvae and a fourth contained pupae. Each egg or larva or pupa, was placed singly in a separate vial.

Observations and experiments on the general biology of the insect, were made daily at a constant temperature (30° C.) and a constant humidity (75% R.H.). The eggs laid by each female were counted, and the cast larval skins were regularly removed. The moult was credited in each case, to the day upon which the exuvium was found. The date of pupation was recorded when the median dorsal split appeared in the fourth larval skin.

An attempt to test the effect of relative humidity on the duration of development, the longevity, the fecundity of the adult, etc., was also made.

For this purpose, desiccators with well fitted and slightly greased lids were used. Each desiccator contained at the bottom about 200 cc. of analar sulphuric acid of the desired concentration. These concentrations of the acid solution were prepared according to Buxton (1931). The relative humidities produced by the various acid concentrations were controlled before use by means of an Edney's paper hygrometer. All humidity experiments were conducted at a more or less constant temperature (30° C.). The relative humidities used in the course of these experiments were 0, 10, 35, 75, 96 <sup>(1)</sup> and 100%. To obtain a more or less 100% R.H., pure water was used at the bottom of the desiccator.

For lack of equipment, it was not possible to test the effect of temperature in a similar manner as the humidity. Therefore, the effect of only one temperature, other than 30° C., was studied. This was 35.5° C. (relative humidity being constant, 75%).

The eggs, larvae, pupae and adults used in all the above experiments were taken from a stock kept at a constant temperature (30° C.) and a constant relative humidity (75%).

The food used, unless otherwise stated, was the Lebbek mealy-bug "*Pseudococcus filamentosus* Ckll."

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(1) 90% R.H. was used instead of 96% in the experiments on eggs, larvae and pupae.

The results obtained from all these laboratory experiments were tested statistically.

The biological observations and experiments carried out in the course of this work continued for about three years.

Whole mounts of the eggs, larvae and pupae were made. The eggs were better examined from specimens coloured with 1% acid fuchsin solution. Larvae and pupae were stained either with acid fuchsin or light green.

The external morphology of the fourth stage-larva was best studied while the latter was alive, since in stained preparations the body sutures became indistinct. The larva was placed in the middle of a cavity slide, and was then covered by a cover slip which was sealed to the slide. In this position, the larva remained alive for a long period. The sutures and the muscle marks of the body were clearly seen during the process of body contraction and relaxation.

The internal organs of the larva were studied from freshly killed specimens, dissected under the binocular microscope.

All drawings were made with the aid of the camera lucida.

### III. BIOLOGY

#### A. The adult stage

##### 1. Emergence

The adult emerges from the pupal skin through a transverse slit which appears anteriorly, and extends along the sides of the pupa. Before leaving the pupal skin, the adult usually remains for a period, varying from two to three days, under the lifted pupal covering, until its body becomes fully chitinated, and has completely acquired its normal colour. It then crawls out sluggishly, and stays motionless for a while, after which it moves about very actively searching for its food.

##### 2. Habits of the adult

The adult moves very actively and much often takes to the wing, but when disturbed it folds its antennae and legs against the body and feigns death. It also ejects a yellow liquid from the articular membranes. This phenomenon was called reflex bleeding by McIndoo (1916).

The adults are specific feeders. They are predaceous, and their most preferable food are the eggs, nymphs and adults of the Lebbek mealy-bug "*Pseudococcus filamentosus* Ckll." and the Hibiscus mealy-bug "*Phenacoccus hirsutus* Green."

When other mealy-bugs and scale insects, such as *Icerya purchasi* Mask., *Icerya aegyptiaca* Douglas and *Chrysomphalus ficus* Ril. were offered as food, it was noticed that the adults of *Hyperaspis* always avoided them and did not prey upon any of them.

The adults of *Hyperaspis* prefer young nymphs of the Lebbek mealy-bug, and consumes much of these during their life. They also attack the eggs but to a less extent. When young nymphs are not available, the adult *Hyperaspis* attacks larger nymphs and females.

The mode of feeding is simple. The prey is captured between the mandibles, and the soft parts of the body are devoured through the punctures made by the mandibles, leaving the empty egg shell or exoskeleton of the prey.

The adults are cannibalistic. It was repeatedly observed that they show much likeness to their own eggs. They attack the latter especially when their food is not available. This phenomenon was also observed, but to a much less extent, when food was abundant.

### 3. Mating and oviposition

Parthenogenetic reproduction does not occur, and the unmated female deposits a relatively very few number of eggs, which soon shrivel and collapse.

It has been found that repeated copulation was essential to ensure the continuous production of fertile eggs, and when mating was slightly delayed, the female soon deposited few unfertile ones. This was reported from a number of Coccinellid beetles by Clausen (1916). But in some other Coccinellids, e.g. *Adonia variegata* Goeze (Kapur 1942) and *Exochomus flavipes* Thubg. (Geyer 1947), the contrary was observed, i.e. repeated copulation was found to be not essential for the continuous production of fertile eggs, a single mating was found enough for the deposition of a great number of eggs for a long period.

### 4. Longevity of the adult

At 30° C. and 75 % relative humidity, the adult insect lived for about 135 days.

TABLE I  
The effect of temperature on longevity  
(Relative humidity 75 %)

| TEMPERATURE<br>IN °C | LENGTH OF LIFE IN DAYS |         |         |         |         |         | AVERAGE<br>BOTH<br>SEXES |
|----------------------|------------------------|---------|---------|---------|---------|---------|--------------------------|
|                      | FEMALE                 |         |         | MALE    |         |         |                          |
|                      | Minimum                | Maximum | Average | Minimum | Maximum | Average |                          |
| 30                   | 60                     | 206     | 135.5   | 78      | 192     | 133.7   | 134.6                    |
| 35.5                 | 61                     | 129     | 80.3    | 49      | 131     | 86      | 83.2                     |

One of the experiments however, showed that the maximum length of life of the female was 206 days, and that of the male was 192 days. The minimum length of life of both the female and the male was found to be 60 and 87 days respectively.

When the temperature was raised to 35.5° C., it was observed that the average longevity of the adult was shortened (Table I).

Similarly, when relative humidities other than 75% were used (temperature 30° C.), the longevity of the insect changed (Table II).

TABLE II  
*The effect of relative humidity on longevity*  
(Temperature 30° C.)

| RELATIVE HUMIDITY | LENGTH OF LIFE IN DAYS |         |         |         |         |         | AVERAGE BOTH SEXES |
|-------------------|------------------------|---------|---------|---------|---------|---------|--------------------|
|                   | FEMALE                 |         |         | MALE    |         |         |                    |
|                   | Minimum                | Maximum | Average | Minimum | Maximum | Average |                    |
| 0                 | 37                     | 80      | 54      | 21      | 84      | 50.7    | 52                 |
| 10                | 46                     | 138     | 83.7    | 64      | 136     | 99.2    | 91.5               |
| 35                | 74                     | 163     | 124.8   | 98      | 199     | 152     | 138.4              |
| 75                | 60                     | 206     | 135.6   | 78      | 192     | 133.8   | 134.6              |
| 96                | 57                     | 128     | 78.6    | 72      | 79      | 74.3    | 76.5               |
| 100               | 13                     | 20      | 16      | 5       | 23      | 15      | 15.5               |

Generally, there was a gradual increase in the longevity of both the female and the male, as the relative humidity increased from 0 to 35 or 75%. From 75 to 96%, a decrease in the length of life of the adults was observed (Table II). At saturation, i.e. 100% R.H., the mean longevity of both the female and the male was very low, being only 16 to 15 days respectively. This may be due to the drowning of the adults in the condensed water, and also to the rapid development of fungi on their food.

Judging from the results obtained from these laboratory experiments, the longevity of the female was nearly the same as that of the male, except at lower relative humidities (10 and 35%), where the male lived longer.

It was also found, that the most favourable relative humidity, for maximum longevity of both sexes, was 35 and 75%.

##### 5. Pre-oviposition period

The duration of the pre-oviposition period was determined by the number of days elapsing from the date on which the female emerged from the pupa to the date of deposition of the first batch of eggs. This period corresponds more or less to the period of maturation of the gonads (Uvarov 1931).

At 30° C. and 75 % relative humidity, the average duration of the pre-oviposition period lasts about two days. In some cases however, it may last for one day, while in some other cases it may be prolonged to four days.

When the temperature was raised to 35.5° C., no significant effect was observed (Table III).

TABLE III  
*The effect of temperature on the duration  
of the pre-oviposition period  
(Relative humidity 75 %)*

| TEMPERATURE<br>IN °C | PRE-OVIPOSITION PERIOD<br>IN DAYS |         |         |
|----------------------|-----------------------------------|---------|---------|
|                      | Minimum                           | Maximum | Average |
| 30                   | 1                                 | 4       | 2.3     |
| 35.5                 | 1                                 | 6       | 2.3     |

When relative humidities other than 75 % were used, the results obtained (Table IV) have clearly demonstrated that at very low (0 and 10 %) and at very high (96 and 100 %) relative humidities, the duration of the pre-oviposition period was prolonged. In the latter case however, i.e. at very high humidities (96 and 100 %), the prolongation was more considerable.

TABLE IV  
*The effect of relative humidity  
on the duration of the pre-oviposition period  
(Temperature 30° C.)*

| RELATIVE<br>HUMIDITY | PRE-OVIPOSITION PERIOD<br>IN DAYS |         |         |
|----------------------|-----------------------------------|---------|---------|
|                      | Minimum                           | Maximum | Average |
| 0                    | 4                                 | 4       | 4       |
| 10                   | 4                                 | 4       | 4       |
| 35                   | 1                                 | 6       | 2.6     |
| 75                   | 1                                 | 4       | 2.3     |
| 96                   | 2                                 | 11      | 4.9     |
| 100                  | 2                                 | 12      | 6       |

The shortest duration of the pre-oviposition period seems therefore to occur at 35 and 75 % R.H.

## 6. Fecundity

The results obtained from laboratory experiments have clearly demonstrated that at 30° C. and 75 % R.H., the average number of eggs laid by a single female, during all its life, was 946.7.



When the temperature was raised to 35.5° C., this number was considerably reduced, the average being 569 eggs (Table V).

TABLE V  
*The effect of temperature on fecundity*  
(Relative humidity 75 %)

| TEMPERATURE<br>IN °C | TOTAL NUMBER OF EGGS<br>LAID PER FEMALE |         |         |
|----------------------|-----------------------------------------|---------|---------|
|                      | Minimum                                 | Maximum | Average |
| 30                   | 414                                     | 1449    | 946.7   |
| 35.5                 | 434                                     | 950     | 569     |

Changes in the relative humidity seemed also to have a significant influence on the total number of eggs produced by the female. An examination of Table VI shows that there is an increase of egg production, as the relative humidity increases from 10 to 75%. At a higher relative humidity, e.g. 96 %, a marked decrease in the number of eggs laid is observed. This decrease becomes more obvious at saturation (100 % R.H.).

It is also clear from Table VI, that the relative humidities which seem more favourable for fecundity, and at which more eggs are laid by the female (at 30° C.) is 35 and 75 %. In the latter case however, the number of eggs seems greater. The maximum number of eggs produced by a single female, during the whole of its life, was found to be 1449. Such a high number of eggs was reported only from the Coccinellid beetle "*Hippodamia convergens* Guér." by E.K. Carnes (Clausen 1940).

TABLE VI  
*The effect of relative humidity on the fecundity*  
(Temperature 30° C.)

| RELATIVE<br>HUMIDITY | TOTAL NUMBER OF EGGS<br>LAID PER FEMALE |         |         |
|----------------------|-----------------------------------------|---------|---------|
|                      | Minimum                                 | Maximum | Average |
| 0                    | 123                                     | 389     | 265     |
| 10                   | 28                                      | 541     | 230.7   |
| 35                   | 467                                     | 1012    | 744.3   |
| 75                   | 414                                     | 1449    | 946.7   |
| 96                   | 120                                     | 526     | 322.9   |
| 100                  | 11                                      | 212     | 102.9   |

The results obtained from the foregoing experiments, on longevity, pre-oviposition period and fecundity, have thus shown that 35 and 75 % relative

humidities (temperature 30° C.), seem to be the most favourable for maximum longevity of both sexes, maximum fecundity and minimum duration of the pre-oviposition period. In the pre-oviposition and fecundity experiments however, the results obtained suggest that 75% R.H. seems to be more suitable still than 35%.

### B. The egg stage

The eggs of *Hyperaspis vinciguerrae* Capra are either laid singly or in clusters. Each cluster contains a number of eggs varying from two to twenty five. Frequently the eggs are deposited in exposed situations. They are laid on the upper surface of the egg-masses of the prey, on both surfaces of the leaves and less frequently on the bottom of the containing vial. Sometimes

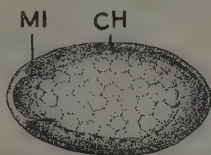


Fig. 1 : Egg (CH, chorion; MI, micropylar canal),  $\times 46$ .

the eggs are laid slanting, one lying half over the other. The egg is usually fixed by its whole ventral surface to the object on which it is deposited.

The egg (Fig. 1) is elongate and oval in shape. It is dorso-ventrally flattened, and with one end broader than the other. The average length of the egg is 0.63 mm. and the average width is 0.36 mm. Two micropylar canals (MI) can be seen, one on either side of the anterior end of the egg. The chorion (CH) is very thin and delicate, and is minutely reticulated with pentagonal areas.

When first laid, the egg is pale-yellow to yellowish-orange in colour. This soon changes to dark yellow. The unfertile egg differs morphologically from the fertile one. It is slightly smaller, pyriform with a more tapering anterior end and a broad rounded posterior end. Unlike the fertile egg, it is usually attached to the object on which it is deposited by its rounded posterior end only. In other words, it is attached with its longitudinal axis at right angle to the surface of attachment. Unfertile eggs are always laid singly.

When the fertile egg is about to hatch, its colour changes to dirty grey, and three black spots can be seen through the chorion in the thoracic region of the future larva, towards the right side.

The larva leaves the egg through a longitudinal slit, which starts a short distance from the anterior end of the egg, towards the right side, and extends downwards till the middle of the egg.

## 1. Incubation period

At 30° C. and 75 % relative humidity, the average duration of the incubation period was 5 days. When the temperature was raised to 35.5° C., the average duration was slightly shortened (Table VII).

Similarly, the effect produced by using relative humidities, other than 75 %, on the average duration of this period, was insignificant (Table VIII). Maximum and minimum durations recorded at relative humidities ranging from 0 to 100 % were 6-7 and 4-5 respectively.

TABLE VII  
*The effect of temperature on the incubation of the eggs*  
(Relative humidity 75 %)

| TEMPERATURE<br>IN °C | TOTAL NUMBER OF EGGS<br>LAID PER FEMALE |         |         |
|----------------------|-----------------------------------------|---------|---------|
|                      | Minimum                                 | Maximum | Average |
| 30                   | 4                                       | 6       | 5       |
| 35.5                 | 3                                       | 5       | 4.3     |

*Incubation period  
in days*

The effect of the relative humidity on the percentage of eggs hatched was also tested. Such effect was found to be great. In complete dryness (0 % R.H.) and at saturation (100 % R.H.), the percentage becomes distinctly low. In both cases, about 40 % of the total number of eggs only hatched.

TABLE VIII  
*The effect of relative humidity*  
*on the incubation of the eggs*  
(Temperature 30° C.)

| RELATIVE<br>HUMIDITY | TOTAL NUMBER OF EGGS<br>LAID PER FEMALE |         |         |
|----------------------|-----------------------------------------|---------|---------|
|                      | Minimum                                 | Maximum | Average |
| 0                    | 5                                       | 6       | 5.4     |
| 10                   | 5                                       | 6       | 5       |
| 35                   | 4                                       | 6       | 5.3     |
| 75                   | 4                                       | 6       | 5       |
| 90                   | 5                                       | 7       | 5.7     |
| 100                  | 4                                       | 6       | 5       |

*Incubation period  
in days*

The highest percentage of the eggs which succeeded to hatch occurred at 35 and 75 % R.H. In this case about 12 % of the total number of eggs used, failed to hatch.

It seems therefore, that the relative humidities at which maximum hatching is likely to occur are here again 35 % and 75 %.

### c. The larval stage

As in nearly all Coccinellids, there are four larval instars in the larval stage of *Hyperaspis vinciguerrae* Capra. In *Hyperaspis lateralis* Muls., four larval instars were described from the spring generation, while three larval instars were described from the fall generation (McKenzie 1932).

The larval instars of *Hyperaspis vinciguerrae* Capra are not covered by any waxy secretion, although it has been generally known that the body of the larvae of the genus *Hyperaspis* is protected by waxy tufts (Boving 1917, Gage 1920, McKenzie 1932 and Balduf 1935).

#### 1. Habits of the larvae

Soon after the hatching of the egg, the first stage larva moves actively seeking for its food, which consists mainly of the eggs of the prey. If these eggs are not available, the larva soon dies.

Prior to each moult, the larva stops feeding and attaches itself by its tenth abdominal segment to any object within its reach. Then, the skin splits along its mid-dorsal line, from the posterior margin of the head to the fourth abdominal segment. The larva frees itself, prothorax first, followed by the head and then the abdomen, leaving the old skin attached to the object.

The newly moulted larva does not start feeding at once, but remains for a while, until the body attains its full chitinization.

During feeding, it was noticed that the larva remains inside the egg-mass of the prey and does not come out, except when searching for another fresh food supply.

When the larva is touched, it emits a drop of sulphur-yellow fluid from one or two of the repugnatorial apertures adjacent to the touch. When the disturbance ceases, the outer surface of the drop dries out, and forms a cover or crust to the still liquid-underlying part of the drop. This is soon sucked back by the larva, leaving the dry crust attached to the aperture. This crust then, falls off during the subsequent movement of the larva.

This process is carried out with great rapidity and apparently the fluid serves as a repellent (Taylor 1935).

The young larvae prefer the eggs of the Lebbek mealy-bug "*Pseudococcus filamentosus* Ckll.", while the full grown larva feeds on both the eggs and small nymphs. In the absence of these, the larva attacks the females.

The mode of feeding of the larva is similar to that previously described in the adult.

During the larval stage, feeding is almost continuous and the most voracious is the mature larva. It consumes an amount which is nearly similar to

or even more than the amount consumed by the three larval instars together.

The larvae, like the adults, are cannibalistic. They attack their weaker kins, either of the same or earlier instars. This occurs when their food is not available. In all the observations made, the larva never attacked the eggs, although the contrary happens in many other Coccinellids.

### Parasites

A specimen of *Acacia* species, which was largely infested with the Lebbek mealy-bug, was brought to the laboratory during July and August 1948. This specimen contained numerous larvae of *H. vinciguerrae* Capra. Some of the mature larvae were seen to be parasitized by a hymenopterous species, probably the Encyrtid "*Homalotylus* sp.". The larvae and the pupae of this parasite were seen inside the body of the already dead and dried *Hyperaspis* larvae.

An attempt to collect similar parasitized specimens from the field, with the object of rearing the parasite, ended in vain, as the larvae collected after that were always clean and unparasitized.

### 2. Duration of the larval stage

At 30° C. and 75 % R.H., the average total duration of the larval stage was 10.3 days. When the temperature was raised to 35.5° C. the average duration was 8.8 days, i.e. about one and a half days less.

TABLE IX

*The effect of temperature on the duration  
of the developmental stages  
(Relative humidity 75 %)*

| TEMPERATURE<br>IN °C | AVERAGE<br>INCUBATION<br>PERIOD<br>IN DAYS | AVERAGE DURATION<br>OF THE<br>FOUR LARVAL INSTARS<br>IN DAYS |        |       |        | AVERAGE TOTAL<br>LARVAL DURATION<br>IN DAYS | AVERAGE<br>PUPAL DURATION<br>IN DAYS | AVERAGE<br>DURATION<br>OF LIFE-CYCLE<br>IN DAYS |
|----------------------|--------------------------------------------|--------------------------------------------------------------|--------|-------|--------|---------------------------------------------|--------------------------------------|-------------------------------------------------|
|                      |                                            | First                                                        | Second | Third | Fourth |                                             |                                      |                                                 |
| 30                   | 5                                          | 1.2                                                          | 1.1    | 1.9   | 6      | 10.3                                        | 9.6                                  | 24.9                                            |
| 35.5                 | 4.3                                        | 1                                                            | 1      | 1     | 5.7    | 8.8                                         | 8                                    | 21                                              |

When relative humidities, other than 75 % were used, it was found that the duration was prolonged, the prolongation being more obvious (by more than two days) at very low humidities, namely at 0 and 10 %. Table X).



### D. The pupal stage

When ready to pupate, the fourth larva stops feeding and leaves the egg-mass of the prey (except at high temperature where it remains protected inside the egg-mass). It attaches itself to the bottom of the containing vial by its anal segment with an adhesive secretion. It then remains quiescent, and gradually hunches up its back. This marks the beginning of prepupation. The larva then secretes a waxy fluffy material on both sides of its body, as well as on the mid-dorsal line. These waxy tufts are segmentally arranged along the thorax and the abdomen. The length of these tufts, differs with individual larvae existing under the same conditions, but generally they are longer in the larvae reared under high temperature (e.g. 35.5° C.) and high humidity (e.g. 90 and 100 % R.H.).

TABLE X

*The effect of relative humidity on the duration  
of the developmental stages  
(Temperature 30° C.)*

| RELATIVE<br>HUMIDITY<br>PERCENTAGE | AVERAGE<br>INCUBATION<br>PERIOD<br>IN DAYS | AVERAGE DURATION<br>OF THE<br>FOUR LARVAL INSTARS<br>IN DAYS |        |       |        | AVERAGE TOTAL<br>LARVAL DURATION<br>IN DAYS | AVERAGE<br>PUPAL DURATION<br>IN DAYS | AVERAGE<br>DURATION<br>OF LIFE-CYCLE<br>IN DAYS |
|------------------------------------|--------------------------------------------|--------------------------------------------------------------|--------|-------|--------|---------------------------------------------|--------------------------------------|-------------------------------------------------|
|                                    |                                            | First                                                        | Second | Third | Fourth |                                             |                                      |                                                 |
| 0                                  | 5.4                                        | 2.2                                                          | 2      | 2     | 6.7    | 12.9                                        | 9.1                                  | 27.4                                            |
| 10                                 | 5                                          | 2.4                                                          | 1.4    | 1.8   | 7      | 12.7                                        | 9.5                                  | 27.3                                            |
| 35                                 | 5.3                                        | 1.4                                                          | 1.1    | 1.5   | 7.4    | 11.4                                        | 10.4                                 | 27                                              |
| 75                                 | 5                                          | 1.2                                                          | 1.1    | 1.9   | 6      | 10.3                                        | 9.6                                  | 24.9                                            |
| 90                                 | 5.7                                        | 2                                                            | 1.5    | 1.7   | 6.3    | 11.5                                        | 9.9                                  | 27                                              |
| 100                                | 5                                          | 1.9                                                          | 1.4    | 1.7   | 6      | 11                                          | 8.7                                  | 24.7                                            |

This is followed by pupation, which is effected by the splitting of the fourth larval skin mid-dorsally. The pupa does not exhibit movement of any kind, nor it emits any fluid when touched.

During the transformation of the pupa, the colour of the adult gradually appears in the different organs of the body. The colour appears first in the eyes, two days after pupation and last in the elytra.

When the pupa happens to be detached from the protecting larval skin, it continues to develop normally.

#### 1. Duration of the pupal stage

At 30° C. and 75 % relative humidity, the average duration of the pupal stage was 9.6 days, while at 35.5° C. the duration was 8 days, i.e. one day and a half less (Table IX).

When relative humidities other than 75% were used (Table X) it was found that, the average duration of the pupal stage was shorter by about one day at saturation, and nearly the same at other relative humidities (except at 35% R.H.).

It is now clear from Tables IX and X, that the average total duration of the developmental period, including the egg, the larval and the pupal stages, lasts about 24.9 days at 30° C. and 75% relative humidity.

An increase of temperature by 5.5° C. (from 30 to 35.5° C.) shortens the total duration of the developmental period by about four days. In other words, the average total duration decreases from 24.9 days at 30° C. to 21 days at 35.5° C.

At relative humidities other than 75%, the average total duration of the developmental period is prolonged by about two days, except at saturation, where it is nearly the same (Table X).

#### IV. MORPHOLOGY OF THE LARVAL INSTARS

##### A. The first larval instar

The body of the first larval instar (Fig. 2) is somewhat narrow, and tapers gradually towards its posterior end. The average length of the larva is 0.8 mm. and the average breadth is 0.3 mm. When newly hatched, it is bright-yellow to greenish-yellow in colour. The head is uniformly yellow, and the three ocelli appear as small black spots on either side. As soon as the larva starts feeding, the colour of the body changes to dark yellow, and that of the head changes to yellowish-brown with distinct dark brown pattern.

The prothorax (TH.1) has two dark brown transverse stripes, one on either side of the median axis of the body. Other than these stripes, on the thoracic region, there are four rounded spots. A pair is found on the prothorax one on either side, just posterior to the prothoracic stripes. The other two spots are usually found on the right side of the meso- and the metathorax. The legs are dark brown in colour, with black rings round the joints.

The head of the larva (H) is comparatively large, about the same width as that of the prothorax (TH.1), and nearly equal to it in size. There is no epicranial suture in the head of the first larval instar. In the other species of *Hyperaspis*, this suture does occur (Böving 1917, Gage 1920, and McKenzie 1932). The other head structures of the first larval instar are similar to those of the mature larva.

Segmentation of the body is clearly marked, there being thirteen body segments, three thoracic and ten abdominal. Of the three thoracic segments, the prothorax (TH.1) is the largest and is nearly equal in size to the meso- (TH.2) and the metathorax (TH.3) together. The two latter segments are sub-equal in size. The legs are comparatively long. In the abdomen, nine

segments are only visible dorsally, as the tenth segment is small and lies ventrally below the ninth segment.

### 1. Larval chaetotaxy

The dorsal surface of the body of the first larval instar (Fig. 2) is covered with short clubbed setae.

The head has ten of these clubbed setae, six of these are arranged transversely towards the posterior region, while the remaining four are found on the sides above and below the ocelli.

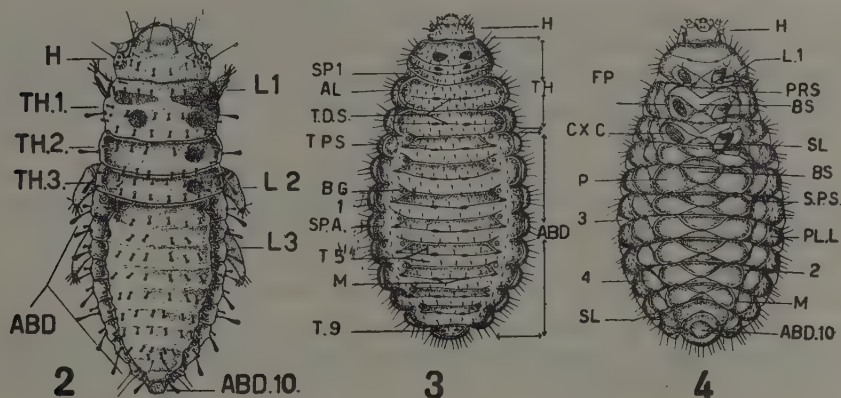


Fig. 2 : First larval instar, dorsal view (ABD, abdomen; ABD.10, tenth abdominal segment; H, head; L1, fore-leg; L2, mid-leg; L3, hind-leg; TH.1, TH.2 and TH.3, pro-, meso-, and metathorax),  $\times 60$ . — Fig. 3 : Fourth larval instar, dorsal view (ABD, abdomen; AL, alary area; BG, repugnatorial aperture; H, head; M, muscle marks; SP.1, mesothoracic spiracle; SP.A., spiracular area; T.5 and T.9, fifth and ninth terga; T.D.S., transverse dorsal suture; TH, thorax; T.P.S., tergo-pleural suture; I, protopleurite),  $\times 12$ . — Fig. 4 : Fourth larval instar, ventral view (ABD.10, tenth abdominal segment; BS, basisternum; CX.C., coxal cavity; FP, furcal pit; L1, fore-leg; P, parasternum; PL.L., pleural lobe; PRS, presternum; SL, sternellum; S.P.S., sterno-pleural lobe; 2, deuteropleurite; 3, tritopleurite; 4, tetrapleurite; other lettering as in Figure 3),  $\times 12$ .

On the rest of the body, the clubbed setae are arranged in the form of transverse rows. Each row is composed of eight setae. In the thoracic region, three rows are found on the prothorax, while two rows are found on the meso- and on the metathorax.

On each abdominal segment, there is only one transverse row.

Projecting from the sides of the body are somewhat longer setae, one on either side of each body segment, except the prothorax which has two on each side. At the base of each long seta, there is a short one.

Non-clubbed setae are found on the anterior margin of the head and the ninth abdominal segment. On the latter, there are four pairs.

On the ventral surface of the body, the setae have no special character or arrangement, and the whole surface is covered with short, non-clubbed setae.

#### B. The second larval instar

The second larval instar is about 2 mm. long, and 0.8 mm. broad. It differs from the first larval instar in the fact that the two dark spots on the meso- and the metathorax have disappeared, while the two anterior dark transverse stripes on the prothorax, and which are now smaller in size, remain together with the two posterior thoracic spots.

All the clubbed setae covering the dorsal surface of the body of the first larval instar are replaced in the second instar by ordinary pointed setae, which have the same number and manner of arrangement. The setae found on the sides of the body of the second larval instar are similar to those found on the body of the full grown larva.

No epicranial arms can be seen in the head of the second larval instar, although two epicranial arms were described by Böving (1917) in the head of the second larval instar of *Hyperaspis binotata* Say.

#### C. The third larval instar

The third larval instar is about 3.4 mm. long and 1.5 mm. broad. Apart from size, there is no morphological difference between this larval instar and the fourth larval instar.

#### D. The last or fourth larval instar

##### 1. External morphology

The mature larva of *Hyperaspis vinciguerrae* Capra (Figs. 3 and 4) is large and fleshy, and measures about 4.5 mm. in length. Its maximum width is about 2 mm. The body of the larva is convex above and slightly concave below. Its colour is greyish white, with very little white mealy secretion scattered all over the body. This secretion is slightly denser round the repugnatorial apertures (BG).

##### a. Head

The head of the larva (Figs. 3 and 4, H) is very small compared with the large fleshy body. It is of the prognathous type. The head is symmetrical and rectangular in form. It is about 0.35 mm. long and 0.5 mm. broad. Its colour is yellowish brown, with dark brown patterns on the dorsal and ventral surfaces. It extends dorsally farther back than ventrally.

##### Head capsule

The head capsule of the larva (Figs. 5, 6, and 7), like that of the adult, is composed of a compound sclerite. There is no epicranial suture, and so

the limits of the cranial areas are obscure. The posterior part of the head can be retracted within the large prothorax.

Dorsally the cranium (Fig. 5) is formed by the vertex (VX) posteriorly, and the frons (FR) and the clypeus (CLP) anteriorly. These sclerites are completely fused together. The clypeus (CLP) lies in the cephalic region of the head, behind the labrum (LR), and from which it is separated by the clypeo-labral suture (CLP.LR.). As the epistomal suture (EP.S.) is but little developed, the clypeus is not well defined from the frons (FR), except on the sides of the head. The anterior margin of the clypeus (CLP), behind the labrum is membranous, while posteriorly it is chitinized and darkly pigmented. Ventrally, on the inner surface of the clypeus, on either side, there is a small knob-like surface of articulation (precoila of Gage 1920), on which the dorsal condyle of the mandible (preartis of Gage 1920) (Fig. 10, D.CO.) fits.

The labrum (Figs. 5 and 7, LR) is attached to the cephalic end of the clypeus, and is separated from it by the clypeo-labral suture (CLP.LR.). The clypeo-frontal area of the head is slightly arched, and so the labrum lies at a slightly lower level than the head. The frons (FR) is a dark brown sclerite carrying a number of short as well as long setae. The vertex (VX) forms the major part of the postero-dorsal surface of the head. On either side of the clypeo-frontal area is the antennal sclerite (Figs. 5 and 7, A.SC.). This is in the form of a well chitinized ring-shaped and dark sclerite surrounding the antennal socket (Fig. 7, A.S.).

Posterior to the antennal sclerite, on either side of the dorso-lateral region of the head, are the three ocelli (O). These are arranged in the form of a triangle. One of them is lateral and lies just behind the antennal ring, while the other two are dorsal in position. These three ocelli are equal in size and each is surrounded by a darkly pigmented and well chitinized area.

The ventro-lateral side of the head is formed by the gena (Figs. 6 and 7, GE). To the outside of this sclerite, and forming part of the ventro-lateral wall of the head, there is the dark and heavily chitinized hypostoma (HST). This is narrow posteriorly and broad anteriorly. The hypostoma is longitudinally flexed in the middle, so that its outer half is at a lower level than its inner half, and thus the mid-ventral region of the head is slightly arched.

Anterior to the maxillary palp (PLP), and near the base of the mandible, the hypostoma (Fig. 7, HST), curves towards the middle of the head, and forms a concavity (post-coila of Gage 1920) (PTI.) into which the ventral condyle of the mandible (Fig. 10, V.CO.) articulates.

Internally the hypostomal ridge is prominent. It is broad anteriorly and tapering posteriorly. Towards its posterior third, the ridge has a triangular



sclerite (Fig. 6) the apex of which lies near the front region of the posterior tentorial pit (PT).

The mid-ventral part of the head is formed by the gula (GU) posteriorly, and the maxillae (MX) and the labium (LB) anteriorly. These are separated from the hypostoma (HST) by a broad membranous area (MM). The gula (GU) is narrow and lies in the middle of the posterior region of the head. It is all membranous, and is laterally limited by the posterior tentorial pits (PT). Posteriorly the gula is continuous with the neck membrane.

The foramen magnum is as wide as the cranium. Its ventral margin, unlike the dorsal, is not chitinated (Fig. 5).

The antenna (Fig. 7, ANT) is embedded in a large antennal socket (A.S.). The antenna is very short; half the length of the maxillary palp, and is three-segmented. It is conical in shape and tapers gradually towards its apex. It is composed of the scape (Fig. 6, SCP), pedicel (PDC), and flagellum (FL). On the distal inner end of the pedicel there is a spine-like seta (T.F.), which may be tactile in function (Böving 1917). The flagellum (FL) is a very small mound-like segment carried on the outer half of the pedicel.

The tentorium (Fig. 8) is represented in the larva, as in the adult, by the posterior tentorial arms. These are invaginated from the posterior tentorial pits (Fig. 6, PT), found on the sides of the gula (GU). The arms (Fig. 8) are comparatively broad triangular plates, extending anteriorly to the middle of the maxilla (Fig. 6, MX), while posteriorly they extend as far as the anterior margin of the prothorax. Near the fore-end of the tentorium, and to the outside, there is a seta-like process (Fig. 8, SE).

#### *Mouth parts*

The mouth cavity is wide and surrounded by the mouth parts. These are the labrum-epipharynx, the mandibles, the maxillae, the labium and the hypopharynx.

The labrum-epipharynx (Fig. 9) is a semi-circular convex sclerite, separated from the clypeus by the clypeo-labral suture (CLP.LR.). Its posterior half is more chitinated than its anterior half. The labrum has eight setae, four of which are near the anterior margin, and the other four are arranged transversely near the middle of the labrum. A pit is found in the middle of the labrum between the setae. Laterally, on either side of the labrum, there is a membranous lobe (M.L.), which was not mentioned before by previous authors who worked on Coccinellid larvae.

The lower surface or epipharynx is membranous and is continuous with the dorsal wall of the pharynx. Posteriorly, on either side of the epipharynx, is attached the dorsal rod of the hypopharynx (Fig. 12, D.R.).

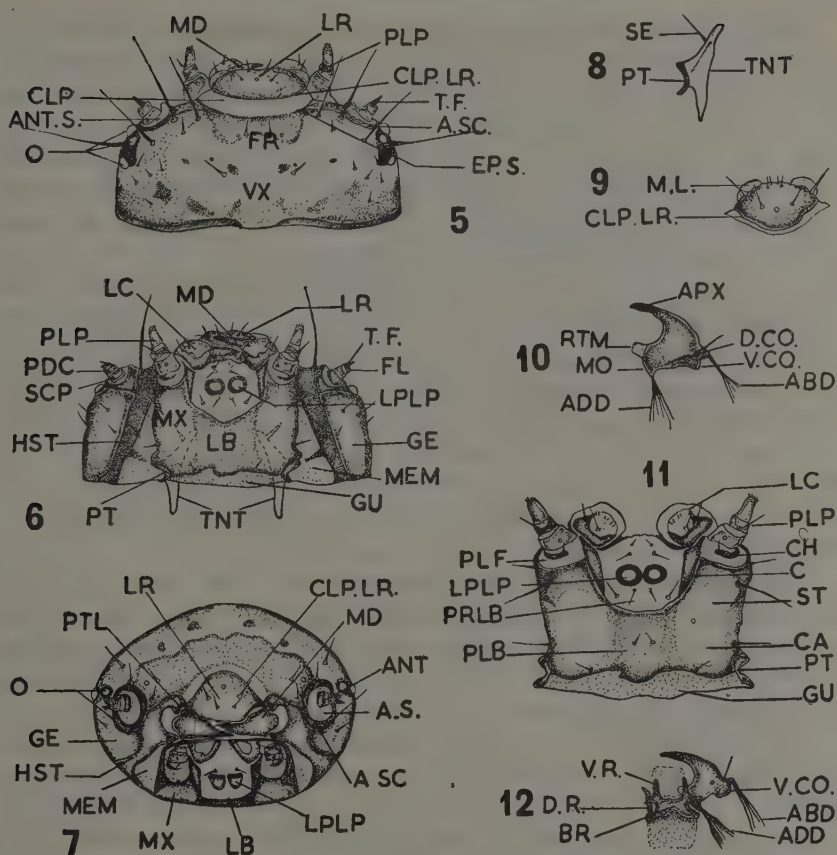


Fig. 5 : Head of the fourth larval instar, dorsal view (ANT.S., antennal socket; A.S.C., antennal sclerite; CLP, clypeus; CLP.LR., clypeo-labral suture; EP.S., epistomal suture; FR., frons; LR, labrum; MD, mandible; O, ocelli; PLP, maxillary palp; T.F., tactile filament; VX, vertex),  $\times 75$ . — Fig. 6 : Head of the fourth larval instar, ventral view (FL, flagellum of antenna; GU, gula; HST, hypostoma; LB, labium; LC, lacinia; LPLP, labial palp; MEM, membrane between maxilla and hypostoma; MX, maxilla; PDC, pedicel; PT, posterior tentorial pit; SCP, scape; TNT, tentorium; other lettering as in Figure 5),  $\times 75$ . — Fig. 7 : Head of the fourth larval instar, front view (ANT, antenna; A.S., antennal socket; PTL, postcoilla; other lettering as in Figures 5 and 6),  $\times 75$ . — Fig. 8 : Tentorium of the larva (PT, posterior tentorial pit; SE, seta-like process; TNT, posterior tentorial arm),  $\times 75$ . — Fig. 9 : Labrum of the larva (CLP.LR., clypeo-labral suture; M.L., membranous lobe),  $\times 75$ . — Fig. 10 : Right mandible (ABD, abductor muscle; ADD, adductor muscle; APX, apex of mandible; D.CO., dorsal condyle; MO, molar area; RTM, retinaculum; V.CO., ventral condyle),  $\times 75$ . — Fig. 11 : Maxilla and labium of the fourth larval instar (C, triangular chitinization; CA, cardo; CH, semicircular chitinization of palpifer PLF; GU, gula; LC, lacinia; LPLP, labial palp; PLB, postlabium; PLP, maxillary palp; PRLB, prelabium; PT, posterior tentorial pit; ST, stipes),  $\times 75$ . — Fig. 12 : Hypopharynx and left mandible of the fourth larval instar (BR, hypopharyngeal bridge; D.R., dorsal rod; V.R., ventral rod; other lettering as in Figure 10),  $\times 75$ .

Each mandible (Fig. 10) is falciform, triangular in shape, with a sharply pointed apex and a broad triangular base. In front of the inner angle of the base, there is the broad molar area (MO). Towards the anterior end of this area is inserted the retinaculum (RTM). The outer side of the mandible bears two condyles, a broad ventral condyle (V.CO.), which fits in the concavity of the hypostoma (Fig. 7, PTL) and a dorsal condyle (Fig. 10, D.CO.), which fits on the inner surface of the clypeus. On the outer side of the mandible near the base there is a moderate-sized seta.

The molar bases of the two mandibles (MO) are widely separated, and work against the concave sides of the hypopharynx (Fig. 12), between the dorsal (D.R.) and ventral (V.R.) rods of the latter. Associated with each mandible are the tendons of the adductor and abductor muscles (ADD and ABD).

The maxilla (Fig. 11) is separated from the hypostoma (Fig. 6, HST) by a large articulating membranous area (MEM). It is formed (Fig. 11) by the fused cardo and stipes, the palpifer, the maxillary palp, and one lobe which was described as the lacinia by Böving (1917) and as the galea by Gage (1920).

The cardo (CA) and stipes (ST) are completely fused together, and are also fused with the labium. They are slightly chitinized. At the base of the cardo, and on either side of the gula (GU), there is the posterior tentorial pit (PT), in front of which there is a seta. Also at the base of the cardo there is another shorter seta.

The anterior end of the stipes (ST) is membranous, and carries the maxillary palp and the lacinia. The stipes has a pair of long setae on its anterior end.

The maxillary palp (PLP) is three-segmented and is carried on a membranous palpifer (PLF), which is strengthened by a semi-circular chitinization (CH). On the inside of this chitinization there is a seta. The basal segment of the palp (PLP) is the largest and is wider than long. The second segment is slightly narrower than the basal one, while the apical segment is conical, and elongated. This last segment bears at its apex a number of short sensory setae. There is also one seta on the second segment of the maxillary palp.

The lacinia (LC) arises from the inside of the anterior end of the stipes (ST). It is a more or less rounded large fleshy lobe, with a well chitinized base. The dorsal surface of the lacinia (LC), towards the mouth cavity, is soft and has two large setae, together with three pairs of very short spine-like setae. Between the lacinia (LC) and the maxillary palp (PLP), there is a triangular chitinized part (C), which extends to the middle of the inner margin of the maxilla.

The galea is wanting. A rudimentary two-segmented galea, which is carried on the anterior and dorsal side of the lacinia was described from *Hyperaspis binotata* Say (Böving 1917).

The labium (Fig. 11) lies in front of the gula (GU), between the maxillae, and forms the middle part of the ventral wall of the head (fig. 6, LB). The labium is composed of the post-labium and the pre-labium. The post-labium (Fig. 11, PLB) is in the form of a darkly pigmented sclerite, which is comparatively well chitinized. It is separated from the gula (GU) by an irregular boundary line. The pre-labium (PRLB) is very weakly chitinized and is completely fused with the ligula (LIG). In the middle of the pre-labium (PRLB) there are the labial palps (Figs. 7 and 11, LPLP), which lie very close to each other. Each palp is composed of a very short dome-like segment which has a chitinized ring at its base. This ring was considered by Böving (1917) as a segment, and thus the labial palp, according to this author, is two-segmented.

The pre-labium (PRLB) carries four pairs of setae, while on the post-labium (PLB) there is only one pair.

The hypopharynx (Fig. 12) is in the form of a tetragonal dorsally concave plate (BR), called the hypopharyngeal plate or bridge (Böving 1917). It lies in the floor of the mouth cavity, and occupies the anterior third of the labium. The hypopharyngeal plate (BR) projects anteriorly forming two pairs of rods, a dorsal pair (D.R.) which is attached laterally to the posterior corners of the labrum on either side of the epipharynx, and a ventral pair (V.R.) which is attached to the sides of the front ends of the labium. Laterally between the bases of the dorsal (D.R.) and ventral (V.R.) rods of the hypopharyngeal plate, there is a concave surface, against which the concave molar part of the mandible (MO) fits and works.

The head is connected with the thorax by a narrow membranous neck, which is broader ventrally than dorsally.

#### b. Thorax and abdomen

Of the three thoracic segments, the prothorax is the broadest segment (Figs. 3 and 4). The pronotum (Fig. 3) is a large trapezoidal sclerite, which is divided into three parts by two transverse sutures. The anteriormost part occupies nearly half the pronotum, and possesses the two oval dark spots, which are here larger in size and more distinct than those of the second larval instar. The posterior suture extends between two muscle marks, and thus corresponds to the suture called by Böving (1917) "the transverse dorsal suture." This suture forks laterally. Anterior to the transverse dorsal suture, there are the posterior oval dark spots similar to those found in the second larval instar.

The meso- and the metathoracic terga are sub-equal in size. Each is divided into two equal portions by the dorsal transverse-suture (D.T.S.), and are separated from the pleural areas on the sides, by the tergo-pleural suture (T.P.S.). The alar areas (AL) lie on the sides of the terga in the meso- and the metathoracic segments.

The abdominal terga conform in shape and size with each other. Each, is composed of the spiracular area (SP.A.) on either side, which is rounded and bears the abdominal spiracle, and a median tergal area. This latter area is divided into two portions by the transverse dorsal suture (T.D.S.), which bears two muscle marks (M). This suture ends laterally opposite to the middle of the spiracular area (SP.A.). The inter-segmental suture, found between two subsequent segments, forks laterally, thus enclosing a triangular area, which carries the aperture of the repugnatorial gland (BG). The ninth abdominal tergum is formed by a triangular piece, the posterior margin of which limits the abdomen posteriorly, as the tenth abdominal segment lies ventrally (Fig. 4, ABD. 10).

The dorsal surface of the larva is covered by short and moderate-sized setae, while the posterior margin of the abdomen is fringed with a number of comparatively long setae.

The tergal areas, the prescutum, scutum, scutellum and parascutum, and which were described from the larva of *Hyperaspis binotata* Say (Böving 1917), are not well defined in the larva of *Hyperaspis vinciguerrae* Capra.

Each pleural area or lateral zone (Böving 1917) of a segment, is separated dorsally from the tergum by the tergo-pleural suture (Fig. 3, T.P.S.) called also the lateral suture by Böving (1917). It is separated ventrally from the sternum by the sterno-pleural suture (Fig. 4, S.P.S.) or sub-lateral suture (Böving 1917). The major part of the pleural area appears ventrally and only a small part is visible dorsally. It is largely composed of an oval central large pleural lobe (PL.L.), which is found ventrally and is surrounded by the proto- (Fig. 3, 1), deuterio- (Fig. 4, 2), trito- (Fig. 4, 3), and tetrapleurites (Fig. 4, 4) (Böving 1917).

The protopleurite (Fig. 3, 1) lies dorsally and is separated from the tergum by the tergo-pleural suture (T.P.S.). The deuteropteurite (Fig. 4, 2) is triangular and lies ventrally adjacent to the sternum, near the cephalic end of the segment. The tritopleurite (Fig. 4, 3) is a small triangular lobe which lies in the postero-lateral region of the segment, behind the pleural lobe (PL.L.), while the tetrapleurite (Fig. 4, 4) is the largest and lies ventrally to the inside of the pleural lobe (PL.L.). The tetrapleurite is convex and cushion-like.

On the lateral margin of the pleural lobe (PL.L.) are five setae, one of which is large and the others are of moderate size, while the surface of



the whole pleural area is pubescent. On either side of the prothorax, there are from six to eight long setae.

Each sternum (Fig. 4) of the larva is separated from the pleuron by the sterno-pleural suture (S.P.S.), which in the thorax lies on the side of the leg. The suture has three muscle marks, one on its anterior end, the other on its posterior end while the third is in the middle.

Each thoracic sternum is divided into the presternum, the basisternum (eusternum of Böving 1917), the sternellum and the parasternum.

The presternum (PRS), in the meso- and the metathorax, is a triangular area which lies in the middle of the anterior end of the segment, and is limited laterally by the two muscle marks, which lie on the anterior end of the sterno-pleural sutures of both sides. In the prothorax the presternum is not well defined. The basisternum (BS) is large in the prothorax, while it is comparatively small and V-shaped in the meso- and the metathorax. Laterally, the basisternum (BS) extends anterior to the meso- and the metathoracic coxae. The parasternum (P) of each thoracic segment, is in the form of two triangular areas, separated from the basisternum (BS) by a suture. The antero-lateral corner of the parasternum (P) is well chitinized and has a condyle for articulation with the coxa of the leg. The sternellum (SL) is a triangular sclerite lying in the middle of the posterior half of the sternum. In each thoracic segment and in the middle of the suture which separates the sternellum (SL) from the parasternum (P), there is a notch which is the furcal notch (FP).

The sterna of the abdominal segments are simpler than those of the thorax. The presternum is here not well defined and the middle of the anterior half of the sternum is formed by the basisternum (BS).

### c. Legs

The legs (Figs. 13, 14 and 15) are small compared with the size of the larva. The prothoracic legs (Fig. 13) are smaller in size than the meso- (Fig. 14) and the metathoracic legs (Fig. 15). The latter are the longest of the three pairs.

Each leg arises from an oval oblique coxal cavity (Fig. 4, CX.C.), found on the side of the sternum of the thoracic segment. The coxa (Fig. 15, CX) articulates with a differentiated and well chitinized part of the antero-lateral side of the parasternum (S).

The leg consists of the coxa (CX) which has a wide base and well chitinized margin. It carries a number of setae and pores. The trochanter (TR) is a triangular segment, movably articulated with the coxa and its margin is well chitinized. The femur (FM) is an elongate cylindrical segment, and is fixedly articulated with the trochanter. The distal and pro-

ximal ends are more chitinized than the other parts of the femur. The tibia (TB) is nearly equal in length to the femur (FM) but much narrower. It tapers distally where it is connected with the tarsus (TAR). Arising from

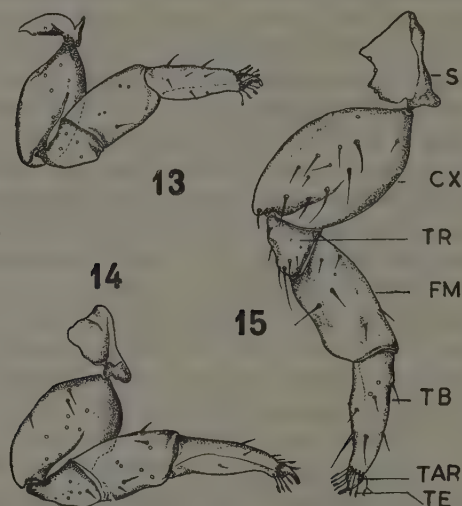


Fig. 13 : Fore-leg of the fourth larval instar,  $\times 75$ . — Fig. 14 : Mid-leg of the fourth larval instar,  $\times 75$ . — Fig. 15 : Hind-leg of the fourth larval instar (CX, coxa; FM, femur; S, part of the parasternum; TAR, tarsus; TB, tibia; TE, tenant hairs; TR, trochanter),  $\times 75$ .

round the distal margin of the tibia (TB) are the peculiar club-shaped setae (TE) known as tenant hairs (Gage 1920). The tarsus (TAR) is composed of one segment which is heavily chitinized and claw-like.

#### d. Repugnatorial apertures

These are eight pairs (Fig. 3, BG), found on the anterior eight abdominal segments. Each pair is in the form of two transverse slits which open laterally one on either side of the tergum of the abdominal segment. Each is surrounded by a circular area differentiated from the tergum.

#### e. Spiracles

The spiracles are nine pairs (Fig. 3, SP), which are all of the same size and are dorsally situated. The first pair or mesothoracic spiracles (SP.1) opens on the membrane between the pro- and mesothorax. Each of the remaining eight pairs, opens on either side of the anterior end of the spiracular area (SP.A.) of the first eight abdominal terga. A rudimentary pair of spiracles is found on the dorsal surface of the metathorax.

## 2. Internal anatomy

### a. Alimentary canal

The alimentary canal of the fourth larval instar (Fig. 16), like that of the adult, is composed of the three primary divisions, the fore-gut or stomodaeum, the mid-gut or mesenteron, and the hind-gut or proctodaeum. The alimentary canal is about one and a half times the length of the body, being only looped in the posterior region of the mesenteron. It is of considerable diameter, especially in the mesenteron, where it nearly fills all the body cavity.

#### *Fore-gut*

The fore-gut is short and extends only as far as the anterior half of the prothorax. Three divisions of the fore-gut can be distinguished, namely the pharynx, the oesophagus and the crop.

The pharynx begins anteriorly from the preoral cavity, and is surrounded by the mouth parts. It is a very small muscular chamber which leads to the oesophagus.

The oesophagus (OES) is a very narrow muscular tube extending posteriorly from the head as far as the anterior end of the prothorax. From there, it gradually broadens out and leads to the thin-walled crop (CR). This latter is a pear-shaped chamber found in the anterior half of the prothorax.

#### *Mid-gut or mesenteron*

The mesenteron (MENT) extends from the posterior half of the prothorax to the end of the eighth abdominal segment. When fully stretched, the mesenteron is nearly equal to the length of the body. The mesenteron (MENT) is the largest and most important section of the alimentary canal. It is separated anteriorly from the crop (CR) by a constriction which is the external indication of the stomodaeal valve. The gastric caeca, like those of the adult, are not well defined.

The mesenteron (MENT) narrows gradually towards its posterior region which forms a ventral loop extending anteriorly from the end of the eighth abdominal segment, then it turns back for a short distance, to join the ileum (IL).

#### *Hind-gut or proctodaeum*

It consists of the ileum (IL), the colon (CLN), and the rectum (RECT). The ileum (IL) begins from the end of the seventh abdominal segment, and extends to the posterior margin of the eighth segment. It is nearly equal in diameter to the narrow posterior region of the mesenteron (MENT). The colon (CLN) is slightly longer than the ileum (IL) and nearly equal to it in diameter. It dilates posteriorly and passes directly into the rectum

(RECT). This latter (RECT) is a short narrow muscular tube. It opens to the outside by the anal aperture, which is situated ventrally on the tenth abdominal segment.

The alimentary canal of the larva is not associated with any type of digestive glands.

#### *Malpighian tubes*

The Malpighian tubes of the larva (Fig. 16) are much similar to those of the adult in number and in their manner of arrangement.

The Malpighian tubes are three pairs, all originating regularly from round the pyloric annulus, between the mid- and the hind-gut. Each pair

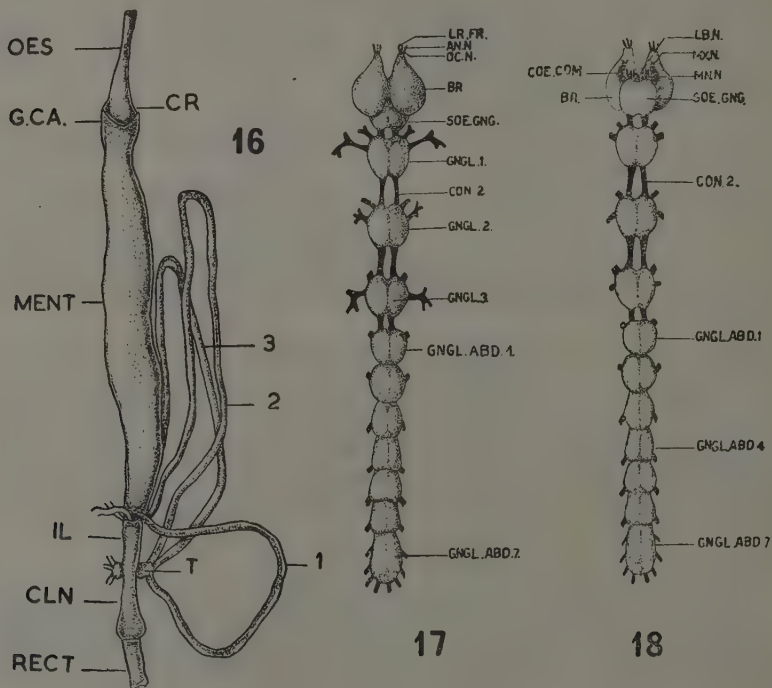


Fig. 16 : Alimentary canal of the larva (CLN, colon; CR, crop; G.C.A., gastric coeca; IL, ileum; MENT, mesenteron; OES, oesophagus; RECT, rectum; T, common trunk; 1-3, Malpighian tubes),  $\times 15$ . — Fig. 17 : Central nervous system of the larva, dorsal view (AN.N., antennal nerve; BR, brain; CON.2, connectives between pro- and mesothoracic ganglia; GNG.L.1, prothoracic ganglion; GNG.L.2, mesothoracic ganglion; GNG.L.3, metathoracic ganglion; GNG.L.ABD.1, first abdominal ganglion; GNG.L.ABD.7, seventh abdominal ganglion; LR.FR., labro-frontal nerve; OC.N., ocellary nerve; SOE.GNG., suboesophageal ganglion),  $\times 46$ . — Fig. 18 : Central nervous system of the larva, ventral view (COE.COM., circumoesophageal commissure; GNG.L.ABD.4, fourth abdominal ganglion; LB.N., labial nerve; MN.N., mandibular nerve; MX.N., maxillary nerve; other lettering as in Figure 17),  $\times 46$ .

is symmetrically situated on either side of the alimentary canal. The two tubes constituting the first pair (1) originate from the dorsal surface, and extend posteriorly towards the anterior end of the colon (CLN). The second and largest pair (2) arises from the sides of the pyloric annulus. It extends anteriorly on either side of the mesenteron (MEN'T) in a zig-zag course, as far as the metathorax, then turns back and reaches the beginning of the colon. The third pair (3) is slightly shorter than the second (2) and originates from the ventral surface of the pyloric annulus. It follows nearly the same course of the second pair (2), but extends only to the first abdominal segment.

Before re-associating the colon (CLN), the three tubes of one side unite together to form a swollen bladder-like common trunk (T) on the side of the colon. The Malpighian tubes of the larva are slightly wider than those of the adult.

#### b. Nervous system

The nervous system of the larva (Figs. 17 and 18) is composed of the brain or supra-oesophageal ganglion, the sub-oesophageal ganglion, and the ventral nerve cord, which runs in the mid-ventral line.

The brain (Fig. 17, BR) is a bilobed structure. Each lobe is pear-shaped, with the narrow apex in front. The two lobes are united with each other in their posterior half. The major part of the brain, i.e. the posterior swollen two thirds, is found in the anterior end of the prothorax, while only the narrow apex is covered by the posterior part of the cranium. From the anterior end of each lobe are given off three nerves, the labro-frontal nerve (LR.FR.) which is the innermost and supplies the labrum and joins the frontal ganglion, the ocellary nerve (OC.N.) which is the outermost and supplies the ocelli, while the antennal nerve (AN.N.) lies in the middle and supplies the antenna. The circum-oesophageal connectives (Fig. 18, COE.COM.) arise from the latero-ventral surface of the anterior end of the brain.

The sub-oesophageal ganglion (Figs. 17 and 18, SOE.GNG.) lies below the brain in the anterior end of the prothorax. It is composed of a single rounded mass which innervates the mouth-parts. These nerves arise from its antero-ventral margin. The mandibular nerve (Fig. 18, MN.N.) arises close to the circum-oesophageal connectives (COE.COM.), and is followed internally by the maxillary nerve (MX.N.). From the middle of the sub-oesophageal ganglion arises the labial nerve (LB.N.).

The ventral nerve cord consists of three thoracic ganglia and seven abdominal ganglia.

The three thoracic ganglia (Fig. 17, GNGL. 1, GNGL. 2, GNGL. 3) are similar in shape and size. Each ganglion lies in the middle of the seg-



ment and supplies it with two pairs of nerves. The commissures between the thoracic ganglia are double. Those between the sub-oesophageal ganglion (SOE.GNG.) and the prothoracic ganglion (GNGL. 1) are very short, while those between the thoracic ganglia are comparatively long.

The abdominal ganglia are found in the first seven abdominal segments. The first abdominal ganglion (Figs. 17 and 18, GNGL.ABD. 1) is connected to the metathoracic ganglion (Fig. 17, GNGL. 3) by short double commissures. The commissures between the abdominal ganglia are wanting. The first three ganglia are rounded and are slightly smaller than the thoracic ganglia. The following three ganglia are conical in shape and are smaller than the former, while the seventh abdominal ganglion (Figs. 17 and 18, GNGL.ABD. 7) is somewhat larger in size and may represent the seventh, eighth, ninth and tenth abdominal ganglia fused together. While each of the first six ganglia innervates its own segment by a pair of nerves, the seventh ganglion gives off four pairs of nerves to supply the remaining four segments.

#### c. Circulatory system

The circulatory system is composed of a simple longitudinal tube, "the dorsal vessel", which extends in the mid-dorsal line below the terga, along the thorax and abdomen. It ends just behind the brain. The dorsal vessel is surrounded by twelve pairs of pericardial cell masses. Also twelve pairs of alary muscles are present and are attached to the inter-segmental folds between the body terga.

#### d. Respiratory system

Nine pairs of spiracles are found in the larva (Figs. 19 and 20). They are all of the same size, ring-shaped, and are provided with an elaborate closing mechanism. All the spiracles are situated dorsally. A rudimentary pair of spiracles (Fig. 21, SP.O.) is found on the dorsum of the metathorax.

In the tracheal system of the larva (Figs. 19 and 20) there are four main longitudinal trunks, two dorsal and two ventral, which extend along the thorax and abdomen. In addition to these, there are two small tracheal trunks, one is dorsal and the other is ventral, and both supply the head region, and communicate with the first or mesothoracic spiracles (SP.1).

The dorsal head trunk (Fig. 19, D.H.TRA.) supplies the dorsal muscles of the prothorax, and the muscles found in the dorsal region of the head. The ventral head trunk (Fig. 20 V.H.TRA.) is more important, and tracheates nearly all the other head structures. It gives off on its course a small branch to the ventral prothoracic muscles and fore legs, and another branch to the sub-oesophageal ganglion. Then the trunk divides and supplies the ventral muscles of the head, the ocelli, the antenna, and the mouth-parts.

The lateral tracheal trunk (Figs. 19 and 20, L.TRA.) extends between the nine pairs of spiracles. In the prothorax it gives two branches, one anterior and the other posterior, to supply the ventral muscles and organs which lie in the prothorax. The anterior branches of both sides unite ventrally and form the first ventral transverse commissure (Fig. 20, V.COM.).

Communicating with each spiracle of the body, as well as the rudimentary metathoracic spiracle (Fig. 19 SP.O.), is a dorsal transverse spiracular trachea (SP.TRA.). This trachea divides into two branches, an upper branch, which runs close to the metatergum, and a lower branch. The upper branches of all the spiracular tracheae of one side unite together to

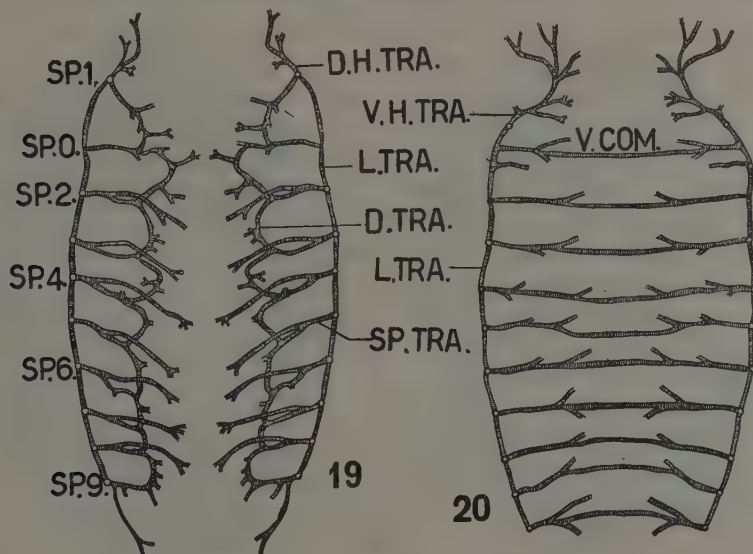


Fig. 19 : Dorsal tracheation of the fourth larval instar (D.H.TRA., dorsal head trunk; D.TRA., dorsal longitudinal trunk; L.TRA., lateral longitudinal trunk; SP.1, mesothoracic spiracle; SP.2-9, first to eight abdominal spiracles; SP.O., rudimentary metathoracic spiracle; SP.TRA., spiracular trachea),  $\times 25$ . — Fig. 20 : Ventral tracheation of the larva (L.TRA., lateral longitudinal tracheal trunk; V.COM., ventral commissure; V.H.TRA., ventral head trunk),  $\times 25$ .

form a dorsal longitudinal trunk (D.TRA.) which runs close to the side of the dorsal vessel. This trunk supplies the tergal muscles, the heart, and the alimentary canal. The lower branch of each spiracular trachea (SP.TRA.) and the nerve ganglion of its segment.

The ventral parts of the body are supplied with tracheae which arise from the spiracles. These take the form of ventral transverse branches. Each branch divides and supplies the ventral body muscles, the alimentary canal and the nerve ganglion of its segment.

In each body segment, the ventral branch of one side becomes connected with that of the other side by a transverse ventral commissure (Fig. 20, V.COM.) which lies below the nerve cord.

The last two body segments, i.e. the ninth and the tenth abdominal segments, are supplied with branches given off from the tracheae which communicate with the eighth abdominal spiracles (SP.9).

## V. MORPHOLOGY OF THE PUPA

At the end of the fourth larval stage, the larval skin splits along the mid-dorsal line from the head to the posterior end of the abdomen. This splitting is apparently due to the pressure exerted by the pupa on the skin.

The pupa (Figs. 21 and 22) is convex with an average length 3.7 mm. and an average breadth 1.72 mm. Its colour is dark yellow. This changes very little during development, except two days before the emergence of the adult, when it becomes distinctly darker. The pupa is enclosed and protected from its ventral surface, which is completely membranous, and also from the sides by the old larval skin which remains attached to it. The dorsal exposed surface (Fig. 21) is strongly chitinized and is covered with sharp, brown, erect and comparatively long spine-like setae.

The head (Fig. 22, H.) is bent ventrally and is rounded anteriorly. It is comparatively overlapped by the large pronotum (Fig. 21, TH. 1). The mouth-parts (Fig. 22) lie over the sternal area of the prothorax. The labrum (Fig. 24,) is an elongated sclerite. It is emarginated anteriorly, and covers the other mouth-parts. The mandible (Fig. 25) has a blunt apex and a broad base. The maxilla and the labium (Figs. 26 and 27) are not divided to their corresponding parts, while their palps are unsegmented and with broad apices. The antenna (Fig. 23) is not segmented and lies on the side of the head. It is composed of a partly hidden cylindrical segment which has a triangular lobe at its base. The pronotum (Fig. 21, TH.1) is large and resembles that of the adult in shape and size. The prosternum is completely membranous, and is hidden partly by the head and partly by the fore pair of legs. The mesotergum (TH.2) is a transverse well chitinized sclerite, extending between the elytra (ELY). The elytra (Figs. 21 and 22, ELY), which are convex, lie on either side of the body, and reach as far as the third abdominal segment. Ventrally they cover the thoracic sterna and extend below the fore and middle legs. The metatergum (Fig. 21, TH.3) is a well chitinized trapezoidal sclerite. The hind wings (Fig. 22, W) lie over the ventral surface of the thorax and are covered by the elytra, while their apices project beyond the latter. The meso- and the metathoracic sterna are membranous and are completely fused together.

Each leg (Fig. 28), is composed of a cylindrical wide segment, which is directly attached to the coxal cavity. This segment may correspond to the femur (FM). The second segment or tibia (TB) is slightly narrower than the femur, and is followed by the tarsus (TAR) which is not segmented and is broad at the apex.

The abdomen (Figs. 21 and 22) is composed of eight segments which taper posteriorly. Of the eight terga, the second and the third are the broadest. Each abdominal tergum is in the form of a transverse narrow and well chitinized band. The eighth tergum (T.8) is triangular in shape and its apex forms the hind end of the abdomen.

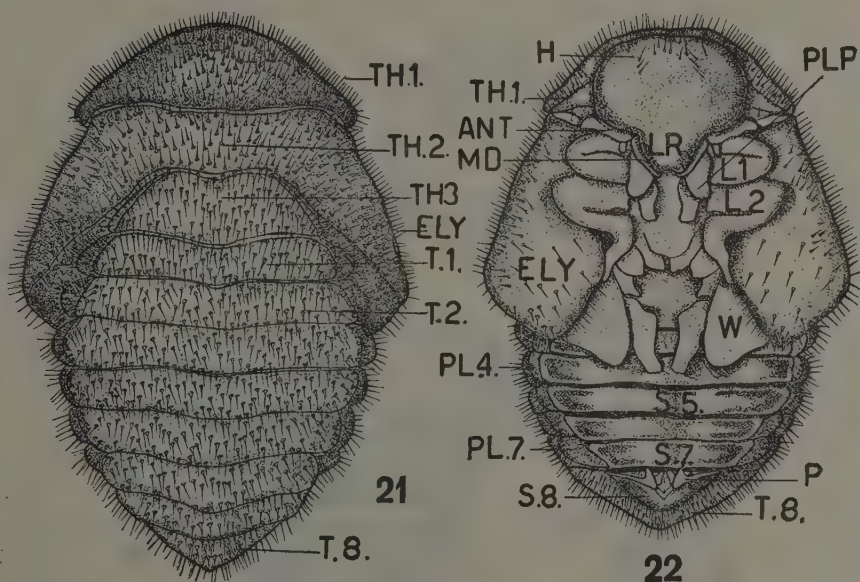


Fig. 21 : Pupa, dorsal view (ELY, elytron; T.1, first abdominal tergum; T.2, second abdominal tergum; T.8, eighth abdominal tergum; TH.1, protergum; TH.2, mesotergum; TH.3, metatergum),  $\times 25$ . — Fig. 22 : Pupa, ventral view (ANT, antenna; H, head; L1 and L2, fore- and mid-leg; LR, labrum; MD, mandible; P, process of eighth sternum; PL.4, fourth pleuron; PL.7, seventh pleuron; PLP, maxillary palp; S.5, S.7 and S.8, fifth, seventh and eighth abdominal sterna; W, wing; other lettering as in Figure 21),  $\times 25$ .

Eight abdominal sterna are distinct (Fig. 28). Of these the first and the second sterna are the broadest. The first seven sterna are membranous, while the eighth sternum (S.8) has a membranous anterior half and a well chitinized posterior half. This latter is covered with spines. A lobe projects from the middle of the eighth sternum on either side of the median line. This lobe carries two processes on its apex (Figs. 22 and 28, P). The extre-



mities of these processes are slightly swollen, and fit into a special cavity in the posterior end of the last larval skin, and thus serve to anchor the pupa to the latter.

The seven abdominal pleura are apparently present (Fig. 28). These are well chitinized, tetragonal in shape and lie between the terga and sterna of the abdominal segments.

The exposed posterior surface of the head, together with the thorax and abdomen are richly covered with spine-like setae. Similar setae, arranged in groups are found on either side of the metathoracic and abdominal terga, while on the ventral surface of the elytra and on the abdominal pleura there are few scattered setae.

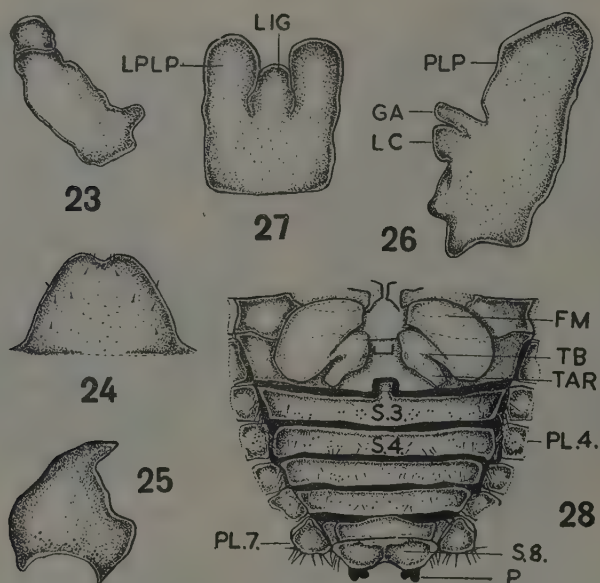


Fig. 23 : Antenna of the pupa,  $\times 75$ . — Fig. 24 : Labrum of the pupa,  $\times 75$ . — Fig. 25 : Mandible of the pupa,  $\times 75$ . — Fig. 26 : Maxilla of the pupa,  $\times 75$ . — Fig. 27 : Labium of the pupa,  $\times 75$ . — Fig. 28 : Abdominal sternal of the pupa (FM, femur; S.3, S.4 and S.8, third, fourth and eighth abdominal sterna; TAR, tarsus; TB, tibia; other lettering as in Figure 22),  $\times 75$ .

## VI. SUMMARY

The present work deals with the general biology of *Hyperaspis vinci-guerrae* Capra and the morphology of the pupa and the larval instars. Of the latter, the fourth larval instar was studied in more detail and its internal anatomy was carefully investigated.



The results obtained from the laboratory studies on the general biology may be summarized as follows :

(1) This species is predaceous in both its adult and larval stages. Its principal food consists of the eggs, nymphs and adults of the Lebbek mealy-bug "*Pseudococcus filamentosus* Ckll." and the Hibiscus mealy-bug "*Phe-nacossus hirsutus* Green."

Other mealy-bugs or scale insects, such as *Icerya purchasi* Mask., *Icerya aegyptiaca* Douglas, and *Chrysomphalus ficus* Ril. are not attacked by this species. Both the adults and larvae of *Hyperaspis vinciguerrae* Capra are cannibalistic in habit.

(2) Repeated copulation is essential to ensure the continuous production of fertile eggs.

(3) At 30° C. and 75 % relative humidity : (a) The average longevity of the male and female is 133.6 and 135.5 days respectively ; (b) The average duration of the pre-oviposition period is about 2.3 days ; (c) The average number of eggs laid by a single female during all its life is 946.7 ; (d) The average total duration of the developmental period lasts about 24.9 days, of which 5 days for the egg stage, 10.3 days for the larval stage and 9.5 days for the pupal stage.

(4) 35 and 75 % relative humidities (temperature 30° C.) seem to be the most favourable for maximum longevity of both sexes, maximum fecundity, maximum hatching and minimum duration of the pre-oviposition period. In the pre-oviposition and fecundity experiments however, it appears that 75 % relative humidity is more suitable than 35 % R.H. Minimum duration of the developmental period seems also to occur at 75 % R.H. (temperature 30° C.).

(5) 35.5° C. seems to be more favourable than 30° C. for the developmental period and less favourable for the longevity of both sexes, and the fecundity of the female.

## VII. REFERENCES

- Balduf, W.V. (1935) : The bionomics of the Entomophagous Coleoptera (J.S. Swift and Co., St. Louis).
- Bodenheimer, F.S. (1933) : Sur la dynamique de fluctuation d'*Icerya purchasi* et de *Novius cardinalis* Muls. (5e Congrès Int. Ent., Paris (1932), 2, pp. 89-91).
- Bodenheimer, F.S. (1943) : Studies on the life-history and ecology of the Coccinellidae. 1. Life-history of *Coccinella septempunctata* L. in four different zoogeographical regions [Coccinellidae : Coleoptera] (Bull. Soc. Fouad I Entom., 27, pp. 1-28).

- Bounhiol, J.J. (1927) : Contribution à l'étude anatomique de la larve du *Leptinotarsa decimlineata* Say (*Rev. Zool. Agric. App.*, Bordeaux, 26, pp. 163-183).
- Boving, A. (1917) : A generic synopsis of the Coccinellid larvae in the United States National Museum, with a description of the larva of *Hyperaspis binotata* Say (*Proc. U.S. National Museum*, Smith. Inst., Washington, 51, No. 2171, pp. 621-650).
- Brues, C. (1946) : Insect dietary (Harvard University Press, Cambridge).
- Bryden, J.W., and Bishop, M.W.H. (1941) : *Coccinella septempunctata* [Coleoptera] parasitised by *Perilitus coccinellae* [Hymenoptera : Braconidae] (*Ent. Mon. Mag.*, 81, pp. 51-52).
- Buxton, P.A. (1931) : Measurement and control of atmospheric humidity in relation to entomological problems (*Bull. Ent. Res.*, London, 22, pp. 431-447).
- Capra, F. (1929) : Sulle forme affini all'*Hyperaspis polita* Wse (*Boll. Soc. Ent. Ital.*, Genova, 61, No. 7, pp. 101-108).
- Clausen, C.P. (1916) : Life-history and feeding of a series of Californian Coccinellidae (Univ. Calif. Public., Technical Bull. 1, No. 6, pp. 251-299).
- Clausen, C.P. (1940) : Entomophagous insects (McGraw-Hill Book Co., New York and London).
- Cutright, C.R. (1924) : Bionomics of *Hippodamia tredécimpunctata* L. (*Ann. Ent. Soc. Amer.*, 17, pp. 188-192).
- Davidson, W.M. (1927) : The biology of *Scymnus nubes* Casey [Coccinellidae : Coleoptera] (*Trans. Amer. Ent. Soc.*, Philadelphia, 49, pp. 155-163).
- Flander, S.E. (1930) : *Lindorus lophantae*, life-history (*Ann. Ent. Soc. Amer.*, 23, pp. 594-596).
- Flander, S.E. (1930) : Wax secretion in Rhizobiini (*Ann. Ent. Soc. Amer.*, 23, pp. 808-809).
- Fluiter, H.J. de (1939) : Beitrag zur Kenntnis der Biologie und Oekologie einiger Coccinelliden von Java (Verh. VII Intr. Congr. Entomol., Berlin, 2, pp. 1106-1119).
- Fullaway, D.T. (1924) : Notes on Coccinellidae (*Proc. Hawaiian Ent. Soc.*, Honolulu, 5, pp. 371-374).
- Gage, G.W. (1920) : The larvae of Coccinellidae (*Illinois Biol. Monogr.*, 6, pp. 233-294).
- Geyer, J.W.C. (1947) : A study of the biology and ecology of *Erochomus flavipes* Thunb. [Coccinellidae : Coleoptera] (*J. Ent. Soc. Southern Africa*, 9, pp. 219-234; 10, pp. 64-109).

- Hall, W.J. (1921) : The Hibiscus mealy-bug "*Phenacoccus hirsutus* Green" (Bull. 17, Min. Agric., Cairo, Tech. Sc. Service, Ent. Section).
- Hall, W.J. (1927) : The introduction of *Cryptolaemus montrouzieri* Muls. in Egypt (Bull. Ent. Res., London, 17, part 4, pp. 385-392).
- Hawkes, O.A.M. (1920) : Observation on the life-history, biology and genetics of the ladybird beetle *Adalia bipunctata* Mulsant (Proc. Zool. Soc. London, pp. 475-490).
- Hawkes, O.A.M. (1927) : The life-history of *Coccinella undecimpunctata* (Trans. Ent. Soc. London, 75 (1), pp. 47-52).
- Hecht, O. (1936) : Studies on the biology of *Chilocorus bipustulatus* [Coccinellidae : Coleoptera], an enemy of the red scale "*Chrysomphalus aurantii*" (Bull. Soc. Fouad I Entom., 20, pp. 299-326).
- Kapur, A.P. (1942) : Bionomics of some Coccinellids predaceous on Aphids and Coccids in North India (Indian J. Ent., New Delhi, 4, pp. 49-66).
- Kapur, A.P. (1944) : On the biology and structure of the Coccinellid *Thea bisoctonotata* Muls. in North India (Indian J. Ent., New Delhi, 5 (1943), pp. 165-171).
- Liu, C.L. (1944) : Contributions to the knowledge of the Chinese Coccinellidae. VI. Occurrence of *Perilitus coccinellae* Schrank, a parasite of adult Coccinellidae in Yunnan [Hymenoptera : Braconidae] (Ent. News, 55, pp. 235-237).
- Liu, Chi-Ying (1932) : Notes on the biology of the two giant Coccinellids in Kwangsi (*Caria dilatata* Fabr. and *Synonycha grandis* Thunbg.), with special reference to the morphology of *Caria dilatata* (Year-book Bur. Ent. Hangchow Chekiang (1933), pp. 205-250).
- McIndoo, N.E. (1916) : The reflex bleeding of the Coccinellid beetle "*Epilachna borealis*" (Ann. Ent. Soc. Amer. 9, pp. 201-223).
- McKenzie, H.L. (1932) : The biology and feeding habits of *Hyperaspis lateralis* Muls. [Coccinellidae : Coleoptera] (Univ. Cal. Publ. Ent., Berkeley, 6, pp. 9-20).
- Moursi, A.A., and Kamal, M. (1946) : Notes on the biology and feeding habits of the introduced beneficial insect "*Leis conformis* Boisd." [Coccinellidae : Coleoptera] (Bull. Soc. Fouad I Entom., 30, pp. 63-74).
- Palmer, M.A. (1914) : Some notes on the life-history of the lady-beetles (Ann. Ent. Soc. Amer., 7, pp. 213-238).
- Pyenson, L., and Sweetman, H.L. (1931) : The effects of temperature and humidity on the eggs of *Epilachna corrupta* Muls. [Coccinellidae : Coleoptera] (Bull. Brooklyn Ent. Soc., pp. 221-226).

- Simanton, F.L. (1916) : *Hyperaspis binotata*, a predatory enemy of the terrapin scale (*J. Agric. Res.*, 6, pp. 197-203).
- Snodgrass, R.E. (1935) : Principles of insect morphology (McGraw-Hill Book Co., New York and London).
- Steinweden, J.B. (1929) : Notes on the origin of wax secretion of certain Coccinellid larvae (*Pan pacific Ent.*, 6, pp. 26-32).
- Taylor, T.H. (1935) : The campaign against *Aspidiotus destructor* Sign. in Fiji (*Bull. Ent. Res.*, London, 26, pp. 1-102).
- Thompson, W.R. (1929) : On the relative value of parasites and predators in the biological control of insect pests (*Bull. Ent. Res.*, 19, pp. 343-350).
- Tuligers (1916) : *Coccinella 7-punctata* and parasite *Perilitus* (*Ent. Tidskr.*, 37, pp. 94-98).
- Uvarov, B.P. (1931) : Insect and climate (*Trans. Ent. Soc. London*, 89, pp. 1-232).
- Vesey-Fitzgerald, D. (1938) : Biological notes on some Coccinellidae from East Africa (*Bull. Ent. Res.*, London, 29, pp. 185-189).
- Vesey-Fitzgerald, D. (1940) : Notes on some Coccinellidae [Coleoptera] from the islands of the Indian Ocean (*Bull. Ent. Res.*, London, 31, pp. 191-192).
- Vesey-Fitzgerald, D. (1940) : The control of Coccidae on coconuts in Seychelles (*Bull. Ent. Res.*, London, 31, pp. 253-283).
- Willcocks, F.C., and Bahgat, S. (1937) : Insects and mites injurious to cotton plants (Royal Agricultural Society, Cairo).
- Wilson, R.E. (1921) : Humidity control by means of sulphuric acid solutions with critical compilation of vapour pressure data (*J. Industr. Engng. Chem.*, 13, pp. 326-331).
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# On the morphology of *Hyperaspis vinciguerrae* Capra

[ Coleoptera : Coccinellidae ]

(with 65 Text-Figures)

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## I. INTRODUCTION

As a contribution to our knowledge of Coccinellid morphology, a detailed study of both the external and internal structure of the Coccinellid beetle *Hyperaspis vinciguerrae* Capra has been undertaken.

The review of literature reveals the fact that comparatively very little was done on the internal anatomy of these insects, with the exception of the alimentary canal. The external anatomy, on the other hand, received more attention by previous workers, e.g. Sharp and Muir (1912), Böving (1917), Gage (1920), Forbes (1922 and 1926), Graham (1922), Stickney (1923), Wilson (1926 and 1930), Tanner (1927), Sweetman (1930), Liu, Chi-Ying (1932), Pradhan (1935, 1937 and 1938), Williams (1945) and Ibrahim (1948).



The present work deals with the external and internal anatomy of *Hyperaspis vinciguerrae* Capra and was carried out in the Department of Entomology, Faculty of Science, Fouad I University, Cairo.

The authors wish to express their sincere thanks to Professor H.C. Efflatoun Bey, Dean of the Faculty and Head of the Department of Entomology, for his assistance and unfailing encouragement.

## II. MATERIAL AND TECHNIQUE

The insects used in the course of the present work were brought fresh from the field, and were reared in the laboratory.

Insects required for microscopic preparations were killed in a KCN tube, and then boiled for about ten minutes in a 10% KOH solution. This was enough to dissolve the internal organs, and to soften the body with slight decolouration of the darkly pigmented chitin. The beetles were well washed with water, transferred to 50 and then to 70% alcohol. The elytra, wings and the different parts of the body were dissected under a binocular microscope. Immediately afterwards, these parts were dehydrated, cleared and mounted as usual in canada balsam.

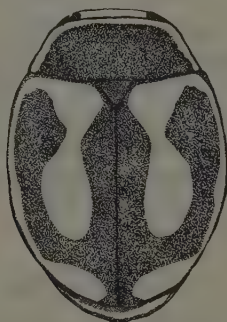


Fig. 1 : Male *Hyperaspis vinciguerrae* Capra, dorsal view,  $\times 17$ .

For studying the internal anatomy, the beetles were anaesthetised with chloroform. They were then dissected with very fine micro-needles in normal saline solution (0.75% NaCl). Permanent preparations of the internal organs (except the tracheae) were made after being stained with borax carmine. For studying the tracheal system, starved individuals were dissected in normal saline solution, and the tracheae were then examined and drawn while they were filled with air.

All drawings were made with the aid of the camera lucida.

### III. EXTERNAL MORPHOLOGY

*Hyperaspis vinciguerrae* Capra (Fig. 1) is a small Coccinellid beetle which is about 2.5 mm. in length and 1.8 mm. in breadth. The body exhibits certain colour characteristics, some of which serve to differentiate between the sexes. For instance, the front region of the head and the anterior margin of the pronotum together with the mesepimeron are yellow in the male and dark brown or almost black in the female.

In both sexes the rest of the pronotum is dark brown except the sides which are yellow. The scutellum is distinct black. The elytra are yellow, with a dark brown, almost black, longitudinal band in the middle. Each elytron, exhibits in the middle a dark brown, almost black, elongated spot. The sides of the elytra are black. A detailed description of the colour pattern of this insect was given by Capra (1929).

#### 1. The head

##### a. Head capsule

The head, as in nearly all the Coleoptera, is of the prognathous type. It is broader than long and its breadth is nearly twice its length. The two eyes together, occupy nearly half the dorsal area of the head.

The head capsule (Figs. 2, 3 and 4) is composed of a compound sclerite, in which the cranial areas are not well defined, and the sutures are obsolete. The Y-shaped epicranial suture is absent.

The posterior part of the head or the epicranium (Fig. 2), can be retracted in the prothorax in repose. The broad plate between the two compound eyes (E), and which extends in front of the fronto-clypeal suture (EP.S.), is composed of the vertex (VX) posteriorly, and the frons (FR) anteriorly. These two are completely fused together.

The clypeus (CLP) (post-clypeus of Stickney (1923) and ante-clypeus of Snodgrass (1935)) is a fairly broad sclerite, attached to the cephalic margin of the frontal region of the head capsule, and is separated from it by the fronto-clypeal suture or epistomal suture (EP.S.). It is well chitinized, and has on its ventral surface, on both sides, two large and prominent rounded condyles (precoila of Stickney 1923) (Figs. 3 and 4, PR). To each of these, the dorsal condyle of the mandible (Fig. 8, D.CO), articulates.

~~The labrum (Fig. 7) is articulated to the cephalic end of the clypeus by a narrow membrane (preclypeus of Stickney 1923).~~

On each side  
the clypeus is

The labrum (Fig. 7) is articulated to the mandibular articulation, is the antennal sclerite (Fig. 2, A. SC.). The scape of the antenna (Fig. 2, SCP) is inserted into a somewhat deep antennal socket (Fig. 4 A.S.).

On the cephalo-lateral margin of the head, there are two large compound eyes (E). They are oval in shape and sinuate near their anterior margins. The dorsal surface of the eye is uniformly convex, and its facetation is fairly hexagonal. The ocular sclerites (Figs. 2 and 4, OC.SC.) are large and ring-shaped and lie on the periphery of the eyes from the inside (Fig. 2, E).

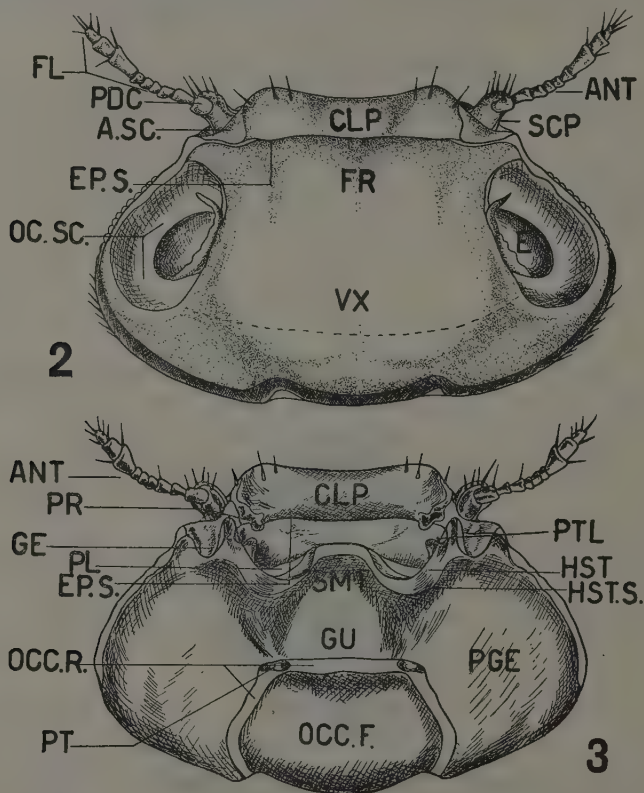


Fig. 2 : Head capsule of adult *Hyperaspis vinciguerrae*, dorsal view (ANT, antenna; A.SC., antennal sclerite; CLP, clypeus; E, eye; EP.S., epistomal suture; FL, flagellum of antenna; FR, frons; OC.SC., ocular sclerite; PDC, pedicel; EP.S., scape of antenna; VX, vertex),  $\times 46$ . — Fig. 3 : Head capsule of adult, ventral view (GE, gena; GU, gula; HST, hypostoma; HST.S., hypostomal suture; OCC.F., occipital foramen; OCC.R., occipital ring; PGE, postgena; PL, paracoila; PR, precoila; PT, posterior tentorial pit; PTL, postcoila; SMT, submentum; other lettering as in Figure 2),  $\times 46$ .

The fusion of the sclerites is continued on the lower side of the head. On the ventral side (Fig. 3), the gula (GU), which lies in the middle, is not distinguished from the neighbouring sclerites, as the gular sutures are

obsolete throughout their length, except for faint lines extending for a short distance cephalad, from the occipital foramen (OCC.F.). The gula (GU) is somewhat elevated posteriorly. The gular pits or posterior tentorial pits (Fig. 3, PT) are found posteriorly on either side of the gula. The gula (GU) is continued anteriorly with the submentum (SMT), with which it is com-

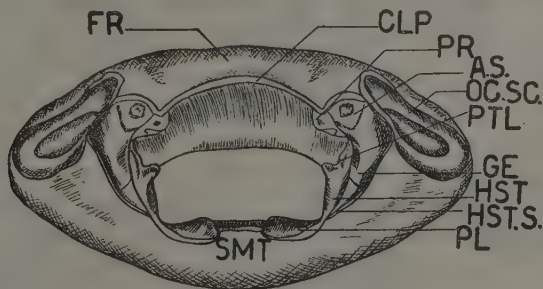


Fig. 4 : Head capsule of the adult, front view (A.S., antennal socket; other lettering as in Figures 2 and 3),  $\times 46$ .

pletely fused. There is no gulo-submental suture, a condition which was also reported from *Coccinella septempunctata* L. (Pradhan 1938).

On either side of the gula (GU) is the postgena (PGE). This constitutes the latero-ventral side of the head capsule (Fig. 3).

The hypostoma (Figs. 3 and 4, HST) is separated anteriorly from the postgena (PGE) by a deep curved suture, the hypostomal suture (HST.S.) (occipital suture of Stickney 1923). On each side of the submentum (SMT), the hypostoma is deeply concave. It forms together with the lateral side of the submentum (SMT) an articular surface (PL) called by Stickney (1923) "the paracosta", into which fits the cardo of the maxilla (Fig. 11, CD). Anterior and somewhat lateral to the paracosta (PL), there is another concavity (PTL) in the hypostoma (HST), called by the same author "postcoila". Into the latter, the ventral condyle of the mandible (Fig. 9, V. CO.), articulates.

The gena (Figs. 3 and 4, GE) is a more or less triangular sclerite, found on the cephalo-lateral sides of the hypostoma (HST), below the eye (Fig. 4). It is slightly concave to receive the flagellum of the antenna, when the latter is folded beneath the head.

#### b. Antenna

The antenna (Fig. 5) is slightly clavate near its apex. As in all *Coccinellidae*, it is composed of eleven segments. It is divided into the scape (SCP), the pedicel (PDC) and the flagellum (FL). The scape or the basal segment (SCP), is a comparatively broad and somewhat rectangular sclerite,



with its proximal end projecting to fit into the antennal socket (Fig. 4, A.S.). On the inner margin of the scape there are four long bristles. The second antennal segment or pedicel (Fig. 5, PDC) is nearly equal in size

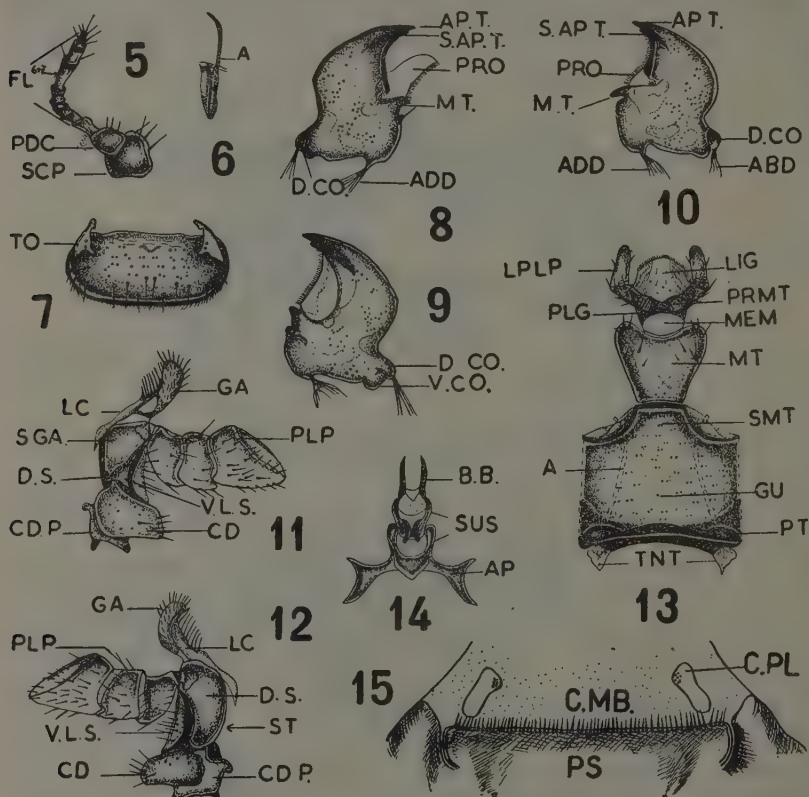


Fig. 5 : Antenna of the adult (FL, flagellum; PDC, pedicel; SCP, scape; 6 + 7, sixth and seventh flagellar segments),  $\times 75$ . — Fig. 6 : Tentorium of the adult (A, posterior tentorial arm),  $\times 75$ . — Fig. 7 : Labrum of the adult (TO, tormae),  $\times 75$ . — Fig. 8 : Left mandible, dorsal view (ADD, tendon of adductor muscle; AP.T., apical tooth; D.CO., dorsal condyle; M.T., median tooth; PRO, prostheca; S.AP.T., subapical tooth),  $\times 75$ . — Fig. 9 : Left mandible, ventral view (D.CO., dorsal condyle; V.CO., ventral condyle),  $\times 75$ . — Fig. 10 : Right mandible, dorsal view (ABD, tendon of abductor muscle; M.T., median tooth; other lettering as in Figure 8),  $\times 75$ . — Fig. 11 : Left maxilla, ventral view (CD, cardo; CD.P., cardo-process; D.S., dorsal sclerite; GA, galea; LC, lacinia; PLP, maxillary palp; S.GA., subgalea; V.L.S., ventro-lateral sclerite),  $\times 75$ . — Fig. 12 : Left maxilla, dorsal view (ST, stipes; other lettering as in Figure 11),  $\times 75$ . — Fig. 13 : Labium, ventral view (A, posterior tentorial arm; GU, gula; LIG, ligula; LPLP, labial palp; MEM, membrane between mentum and prementum; MT, mentum; PLG, palpiger; PRMT, prementum; PT, posterior tentorial pit; SMT, submentum; TENT, tentorium),  $\times 75$ . — Fig. 14 : Hypopharynx of the adult (AP, apophysis; B.B., basal bar; SUS, forked suspensorium),  $\times 75$ . — Fig. 15 : Cervix (C.M.B., cervical membrane; C.PL., cervical sclerite; PS, prosternum),  $\times 46$ .



to half the scape. The flagellum (FL) is composed of nine segments of which the sixth and seventh are imperfectly differentiated from one another. The basal segment of the flagellum is longer and narrower than the pedicel (PDC). The following four segments are short and stout. The ninth flagellar segment tapers towards the apex, and at its end it is surrounded by a number of bristles. In the region of the fourth and fifth segments of the flagellum, the antenna is slightly elbowed, and can be disposed on the concave gena, when folded beneath the head.

#### c. Tentorium

From the gular pits (Fig. 3, PT), at the posterior end of the gula (GU), two apodemes project into the cavity of the head on both sides. From each apodeme a very slender rod, corresponding to the posterior arm of the tentorium (Fig. 6, A), proceeds cephalad. The two arms approach each other towards the middle, near the posterior arms of the forked apophysis of the hypopharynx (Fig. 14, AP).

#### d. Mouth-parts

The mouth-parts are of the biting type. They include the labrum epipharynx, the mandibles, the maxillae, the labium and the hypopharynx.

The labrum-epipharynx (Fig. 7) forms the upper lip of the extra-oral cavity. The labrum is connected with the clypeus by a narrow membrane (preclypeus of Stickney 1923). It is transversely elongated, roughly tetragonal and with a more or less rounded anterior margin. It is dorsally convex and chitinized. The caudal half of the labrum is deeply fenestrated, while a group of large setae are regularly distributed on its anterior half. The bases of these setae appear like large pits.

Towards the lower surface of the labrum is the epipharynx. This is flat, smooth and membranous, and is continuous posteriorly with the roof of the fore-gut. At the junction of the epipharynx with the latter on either side of the labrum, is the tormae (TO). These are chitinized pieces and are more or less triangular in form. Their apices are directed to the outside, while their bases are hook-like and support the cephalo-lateral end of the fore-gut. Short setae surround the anteriormost margin of the labrum-epipharynx.

The mandibles (Figs. 8, 9 and 10) are well developed. Each mandible is a flattened slightly concave structure, with a more or less triangular base and a pointed tip. The latter is armed with two sharp incisor teeth, an apical tooth (AP.T.), which is curved and sharply pointed, and a sub-apical tooth (S.AP.T.), which is shorter than the apical one and is hidden beneath it. The distal half of the inner margin of the mandible, that is, the margin towards the mouth, just beneath the incisor teeth, is slightly

concave and strongly chitinized. It is blade-like with a sharp edge. The triangular base of the mandible, has one of its angles directed inwards and situated near the mouth, while the two other angles point outwards and each bears a condyle, for articulation with the head capsule. The ventral of these condyles (postartis of Stickney 1923) (Fig. 9, V.CO.), is much stronger and larger than the dorsal condyle (preartis of Stickney 1923) (Figs. 9 and 10, D.CO.). The ventral condyle articulates with the postcoila on the hypostoma (Figs. 3 and 4, PTL), while the dorsal condyle articulates with the precoila (PR) on the lower surface of the clypeus.

In the left mandible (Figs. 8 and 9), and little distal to the inner angle of the base, there are two strongly chitinized blunt teeth (M.T.), of which the antero-dorsal is distinctly larger than the postero-ventral (these are called the median teeth by some authors). These teeth are separated from the distal half of the mandible by a deep emargination. In the right mandible, the two teeth are replaced by a single antero-dorsal tooth (Fig. 10, M.T.), which is comparatively large in size, curved and sharply pointed. This tooth of the right mandible works in between the two teeth of the left mandible.

The distal and inner half of the ventral side of the mandible is slightly concave. Into this concavity is borne the movable triangular membranous prosthema (PRO) (submola of Sweetman 1930 and others). Its inner margin is fringed with minute bristles.

Associated with each mandible, there are two chitinized tendons (ADD and ABD), for the attachment of the adductor and abductor muscles, which move the mandible.

The maxilla (Figs. 11 and 12) consists of the usual five parts, the cardo (CD), the stipes (ST), the lacinia (LC), the galea (GA) and the maxillary palp (PLP).

The cardo (CD) is a somewhat triangular sclerite, with the more or less rounded base directed towards the inner side, while the apex is directed to the outside. It is lodged into the concave articular surface of the hypostoma (Figs. 3 and 4 PL), on either side of the labium.

The cardo bears dorsally, on its inner margin an apodeme (cardo process of Sweetman 1930) (Fig. 12, CD.P.). This apodeme projects into the cavity of the head capsule and carries three processes. Two of these are to the inside and situated one above the other, while the third process is directed outwards. These apodemal processes serve for the attachment of muscles. On the ventral side of the cardo, there are few scattered setae.

The stipes (ST) is composed of three sclerotized parts. One of these is dorsal in position and known as the dorsal sclerite (D.S.), while the other two appear from the ventral side. The dorsal sclerite (D.S.) is more or less quadrangular in form, with a broad distal side and a narrow proximal one.

This sclerite in *Hyperaspis* occupies the whole dorsal surface of the stipes, while in *Coccinella septempunctata* L. it is dorso-lateral in position. (Pradhan 1938).

The two other sclerites of the stipes are present on the ventral side (Fig. 11). The subgalea (S.GA.) is a broad triangular plate, the base of which is distal, while its outer side is close to the third sclerite. This latter is termed by Pradhan (1938) the ventro-lateral sclerite (V.L.S.). It is triangular, drum-shaped and fits between the subgalea (S.GA.) and the cardo (CD). Its lateral side is well chitinized, deeply invaginated and forms a groove into which is located the maxillary palp, when the latter is folded.

The lacinia (LC) is carried on the inner dorsal end of the stipes. Its base is narrow, while its distal end is somewhat broad. It has a row of sharp spines on its inner margin. These spines become gradually longer towards the distal end of the lacinia (LC).

The galea (GA) is found on the distal margin of the stipes, ventral and lateral to the lacinia (LC). It is two-segmented, with the basal segment (basigalea or proxagalea of some authors) small, narrow and tubular in form, while the distal segment (distagalea of some authors) is large and has a rounded apex. The galea (GA) carries on its dorsal surface several rows of setae, which are long on the outer margin.

The maxillary palp is four-segmented. The small narrow basal segment articulates with the latero-dorsal corner of the stipes, near the base of the galea (GA). The following three segments become wider and larger towards their distal ends. The apical segment is the largest of the three and is funnel-shaped. The whole surface of the maxillary palp is covered with setae.

The labium (Fig. 13) is composed of the prelabium and the postlabium. The prelabium carries the fused ligula (LIG) and the labial palps (LPLP). The postlabium is composed of the submentum (SMT) and the mentum (MT).

The submentum (SMT) is a heavily sclerotized plate, lying between the maxillary cardines. It is completely fused with the gula (GU). The submentum (SMT) is darker in colour than the surrounding areas of the head capsule, and its sides share in the formation of the depressions (Fig. 3, PL), which receive the maxillary cardines.

The mentum (Fig. 13, MT) is movably articulated to the distal margin of the submentum (SMT), and projects forwards between the bases of the maxillary stipites. It is nearly trapezoidal in form, with its distal end slightly concave. The sides adjacent to the maxillary stipites are more heavily sclerotized than the rest of the mentum. The hypopharynx is attached to the mid-dorsal surface of the mentum.

The prelabium is separated from the postlabium by a wide membranous area (MEM), which allows the upward flexion of the prelabium, and also enables the prementum (PRMT) to retract into the mentum (MT). The prelabium is roughly hexagonal, with its anteriormost margin more or less rounded.

The prelabium is composed of the prementum, ligula and labial palps. The prementum (PRMT) is a well chitinized part lying in between the bases of the labial palps (LPLP). It is separated from the lateral palpiger (PLG) by an oblique suture. The ligula is cushion-like and is divided into three regions by two faint longitudinal sutures. The dorsal surface of the two lateral regions, that is, the surface towards the mouth cavity, is covered with minute spines, arranged in oblique rows. The outer margin of the ligula (LIG) is covered with a row of these spines. Each labial palp (LPLP) is three-segmented. The basal segment is the smallest, while the third segment tapers towards its distal end.

The hypopharynx (Fig. 14) is a flattened membranous fold of the dorsal flap of the postlabial region. It is supported by a complex framework of sclerites, which extends to near the middle of the prelabium. These sclerites are composed of two basal bars (B.B.) and a forked suspensorium (SUS) (Pradhan 1938). The basal bars (B.B.) extend in the floor of the hypopharynx, while the forked suspensorium (SUS) lies on the roof of the hypopharynx. Each basal bar extends backwards and upwards, and almost meets the anterior arm of the suspensorium. The two posterior arms of the suspensorium are connected beneath the buccal cavity by a median rod, and each arm carries a forked apophysis (AP), which extends somewhat laterally to support the wall of the fore-gut. The suspensorium (SUS) is connected with the middle part of the mentum by two vertical small apophyses.

## **2. The cervix**

The occipital foramen (Fig. 3, OCC.F.) is a wide rectangular opening, lying in the ventral and posterior end of the head. The head is connected with the prothorax by the neck or cervix (Fig. 15, C.MB.). This latter is a large membranous area, supported only with two lateral sclerites (C.PL.), lying on both sides. Dorsal and ventral sclerites are completely absent. The lateral sclerites (C.PL.) are slightly chitinized and are disposed longitudinally in the middle of the cervical membrane (C.MB.), between the head and the prothorax. They are broad anteriorly and narrow posteriorly.

## **3. The thorax**

The prothorax articulates freely with the mesothorax and overlaps nearly all its tergal area. The meso- and the metathorax are firmly connected



together in their tergal and pleural regions. The dorsal area of the thorax is nearly as long or slightly longer than the abdomen. The sclerites are well defined in the metathorax, less distinct in the mesothorax and completely fused in the prothorax.

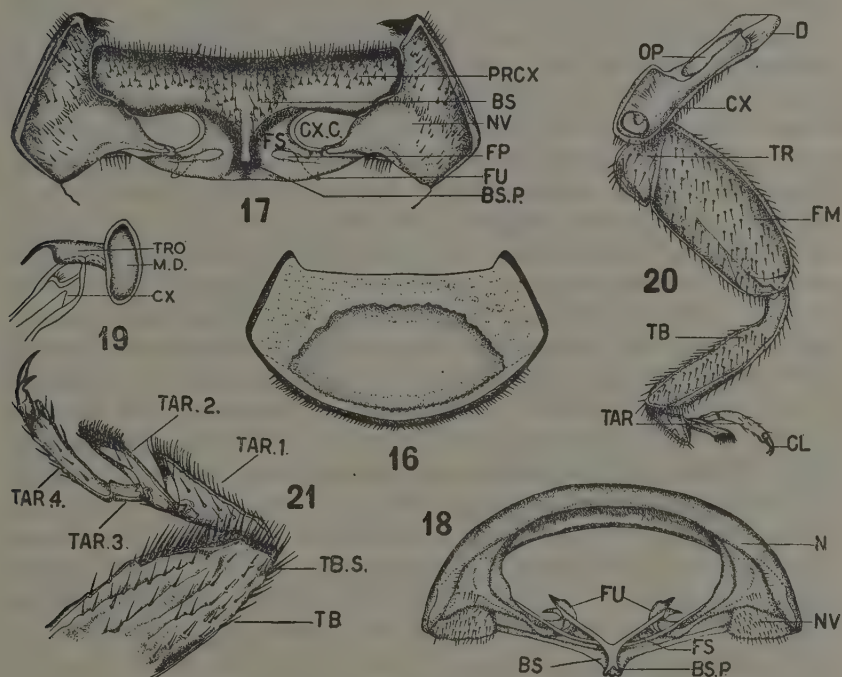


Fig. 16 : Pronotum of the adult,  $\times 33$ . — Fig. 17 : Prosternum of the adult (BS, basisternum; BS.P., sternal process; CX.C., coxal cavity; FP, furcal pit; FS, furcasternum; FU, furca; NV, ventral part of pronotum; PRCX, precoxale),  $\times 50$ . — Fig. 18 : Prothorax of the adult, posterior view (N, notum; other lettering as in Figure 17),  $\times 33$ . — Fig. 19 : Trochantin with the base of the fore-coxa (CX, base of fore-coxa; M.D., muscle disc; TRO, trochantin),  $\times 50$ . — Fig. 20 : Fore-leg (CL, claw; CX, coxa; D, depression of fore-coxa in which the trochantin fits; FM, femur; OP, coxal opening; TAR, tarsus; TB, tibia; TR, trochanter),  $\times 50$ . — Fig. 21 : Terminal part of fore-leg (TAR. 1-4, the four tarsal joints; TB, tibia; TB.S., tibial spur),  $\times 133$ .

#### a. Prothorax

As a result of the complete fusion of the tergal sclerites, the pronotum (Fig. 16) is composed of a transversely elongated plate, about twice as broad as long. It has a cephalic emargination, into which the posterior half of the head is retracted. The pronotum extends ventrally on either side, from the lateral carina to the precoxal bridge (Fig. 17, PRCX), and to the furcasternum (FS). The lateral carina is formed at the folding of the dorsal



and ventral parts of the pronotum. The margins of the ventral part of the pronotum (NV) overlap the propleura and are fused with them (Crampton 1926).

The prosternum (Fig. 17) is well chitinized and is composed of an anterior T-shaped basisternum (BS) and a posterior furcasternum (FS). The basisternum (BS) is a distinctly broad sclerite, which extends between the fore-coxae in the form of a backwardly directed narrow process, called the sternal process (sternal lobe of some authors) (BS.P.). This process is more or less rectangular in form, and is elevated than the rest of the sternum. Each lateral region of the basisternum (BS), anterior to the coxa, is the precoxal bridge or precoxale (PRCX). This fits into a special concavity in the ventral part of the pronotum (NV). The furcasternum (FS) lies in between and behind the coxae. It extends laterally on either side, till it reaches the ventral part of the pronotum (NV). It forms posteriorly the postcoxal bridge or postcoxale. This encloses the coxal cavities posteriorly. Anterior to the coxa, the furcasternum (FS) extends internally and laterally beneath the precoxale (PRCX), and reaches the ventral part of the pronotum on either side. This, together with the posterior margin of the precoxale, form a sort of an inner ridge, which limits the coxal cavity from in front. The furcasternum (FS), lateral to the sternal process (BS.P.) is concave. Into this concavity fits the procoxa. On each side of the sternal process (BS.P.), there is a comparatively large and oval shallow pit, transversely disposed in the furcasternum (FS). This is the furcal pit (FP), which is the external manifestation of the furca (Fig. 18, FU). This latter projects dorsally into the cavity of the prothorax, as broad apodemes serving for muscle attachments.

The trochantin (Fig. 19, TRO) is the only sclerite present from the propleuron. It lies together with the base of the procoxa (CX) inside the cavity of the prothorax, underneath the ventral part of the pronotum (Fig. 17, NV). It is rectangular in form, and it has a medianly directed process, and a large muscle disc (Fig. 19, M.D.). The trochantin fits into a special depression of the fore-coxa (Fig. 20, D), and is attached to the body wall by a membrane.

#### *Chaetotaxy of the prothorax*

The pronotum is bare dorsally (Fig. 16), except for double minute pits, regularly distributed all over its surface. Its posterior margin has a fringe of stout setae. Also on the ventral part of the pronotum (Fig. 17, NV) there are numerous short setae. The whole surface of the basisternum (BS), and the anterior region of the precoxale (PRCX) are covered with large setae. All the setae, covering the ventral surface of the prothorax are directed forwards.

*Prothoracic leg*

The coxal cavity (Fig. 17, CX.C.) is closed anteriorly by the precoxale (PRCX) and the furcasternum (FS) which extends beneath it, while posteriorly it is closed by the furcasternum (FS) and the inner end of the ventral part of the pronotum (NV).

The coxa (Fig. 20, CX) is transversely elongated, about four times as long as broad. The basal half of the coxa extends into the body cavity, underneath the ventral part of the pronotum (Fig. 17, NV). The coxal opening (Fig. 20, OP), which serves for the entrance of muscles and other internal structures, extends to nearly half the dorsal side of the coxa. The distal half of the coxa, fits into the concave furcasternum (Fig. 17, FS). Few setae are present on the surface and around the margin of the coxa (Fig. 20, CX). At the distal end of the coxa, there is a kidney-shaped fossa into which articulates the condyle of the trochanter (TR). The trochanter (TR) is somewhat triangular in form, with its apex produced into a hook-~~into which articulates the condyle of the trochanter (TR).~~ The trochanter is fixedly articulated with the femur (FM). On the trochanter (TR) is scattered few comparatively long setae. The femur (FM) is a long and stout sclerite, twice as long as broad. It has its anterior and posterior margins almost parallel to one another. Its distal end is more or less rounded, somewhat tapering and deeply grooved in its flexor surface, so as to receive the condyles of the tibia (TB). The whole surface of the femur and its margins are densely covered with long setae. The tibia (TB) is little longer but much slender than the femur. Its proximal end is narrow, and is provided with an anterior and a posterior condyles. Below these condyles, the tibia is narrower and slightly elbowed, so as to fit into a special groove on the anterior margin of the femur, when the leg is folded. The tibia has two sharp spurs (Fig. 21, TB. S.) and a row of large and sharp spines, arranged round its distal edge. At the bases of these spines, the tibia (TB) is strongly chitinized. The margins and the surface of the tibia are covered with numerous setae. There are four tarsal segments. The first (TAR.1) is more or less triangular in shape, with its proximal end narrow and articulating with the tibia, while its distal end is oblique and has a deep fossa, into which fits the second tarsal segment. This latter (TAR. 2), is more or less cylindrical in form, with a narrow base. The disc-like distal end is provided with numerous sensory hairs. The third tarsal segment (TAR.3) is short, somewhat cylindrical in form and fits into a special concavity in the second tarsal segment (TAR. 2), posteriorly, near the middle. The fourth tarsal segment (TAR. 4) is the largest, more or less cylindrical and slightly curved. It bears distally two appendiculated claws, which are subquadrate

at their base (a character which generally defines the members of the genus *Hyperaspis*).

The tarsal segments, except the third (TAR. 3) are provided with comparatively few setae, while a row of these setae is arranged on the anterior margin of the first tarsal segment (TAR. 1):

The prothorax is connected to the mesothorax by a membranous area, into the dorso-lateral sides of which open the mesothoracic spiracles.

#### b. Mesothorax

The mesothorax is the smallest of the three thoracic segments.

The mesonotum (Figs. 22 and 23) is composed of the prescutum (PRS), scutum (SCT) and scutellum (SCL). The prescutum (PRS) is a V-shaped sclerite and is less chitinized than the other sclerites of the mesonotum. The lateral arms of the prescutum are widely separated, and each has an antero-lateral projection, the anterior notal wing process (suralar of Crampton 1926) (A.N.P.). The prescutum carries the prephragma (Fig. 23, 1.PH.) which projects downwards into the cavity of the mesothorax. To this phragma is attached the intersegmental membrane, which joins the prothorax to the mesothorax, as well as the dorsal muscles of the thorax. The prescutum (PRS) extends latero-posteriorly, parallel to the lateral margin of the scutum (SCT).

The scutum (SCT) is a convex sclerite, which is laterally extended on both sides of the scutellum (SCL), posterior to the prescutum (PRS). Its median part is hidden dorsally by the anterior margin of the scutellum (SCL). The sides of both the prescutum (PRS) and the scutum (SCT) form the lateral margin of the mesotergum. The outer side of the scutum (SCT) is slightly invaginated near the middle. Above this invagination, the prescutum is produced into a small blunt projection, which is the posterior notal wing process (P.N.P.). Both the prescutum (PRS) and the scutum (SCT) lie beneath the caudal margin of the pronotum.

The scutellum (SCL) is a triangular sclerite, lying in the middle of the mesotergum. It is the only sclerite from the meso- and the metatergum which is seen externally when the elytra are folded. The base of the scutellum (SCL) is directed forwards and is almost straight, while the apex points backwards. As the scutellum (SCL) lies on a higher level than the rest of the mesotergum, a groove is thus formed on either side. Into this groove fits the antero-inner margin of the elytron. The scutellum (SCL) extends laterally and reaches the outer margin of the mesotergum. This lateral extension of the scutellum (PN) was called by Sweetman (1930) the parascutellum. To the postero-lateral corners of the scutellum on each side (Fig. 23, 2. PH.) is attached a slender and curved rod (Fig. 22, PN.A.). This projects ventrally and backwardly and is inserted on the

upper surface of the lateral arms of the prephragma of the metatergum (Fig. 30, 1.PH.A.). These rods are called by Hopkins (1909) "the lateral arms of the postphragma" (El-Sayed 1940). They are the homologies of the

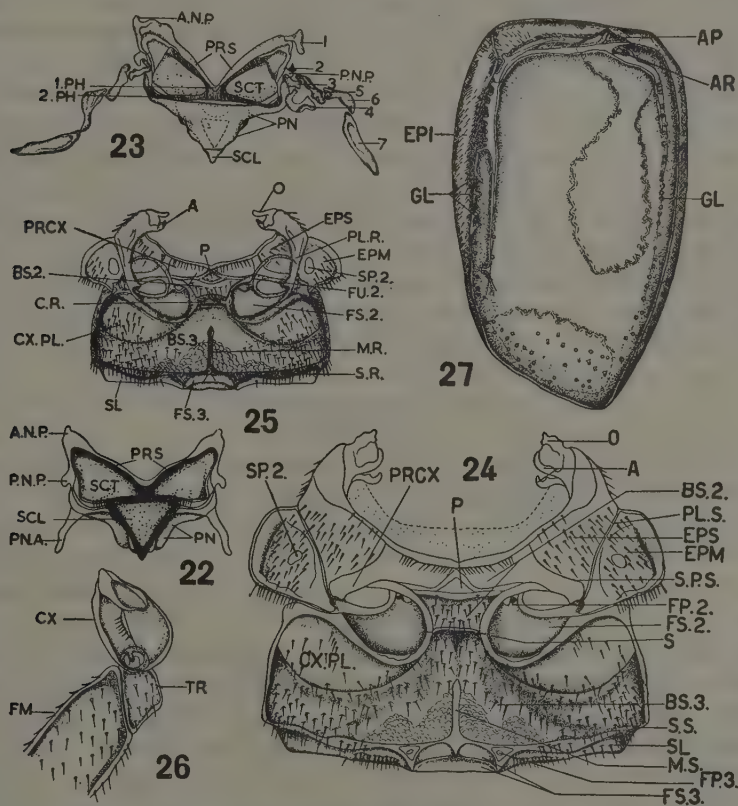


Fig. 22 : Mesothorax of the adult, outer view (A.N.P., anterior notal wing process; PN, lateral extension of scutellum SCL; P.N.A., lateral arm of postphragma; P.N.P., posterior notal wing process; PRS, prescutum; SCT, scutum),  $\times 50$ . — Fig. 23 : Mesothorax, inner view (1.PH, prephragma; 2.PH, lateral corners of scutellum SCL; 1-7, articular sclerites of elytron; other lettering as in Figure 22),  $\times 50$ . — Fig. 24 : Meso- and metasternum of the adult, outer view (A, apodeme for articulation with mesonotum; BS.2, mesothoracic basisternum; BS.3, metathoracic basisternum; CX.PL., meso-coxal plate; EPM, mesepimeron; EPS, mesepisternum; EP.2, mesothoracic furcal pit; EP.3, metathoracic furcal pit; FS.2, mesothoracic furcasternum; FS.3, metathoracic furcasternum; M.S., median suture; O, pleural wing process; P, sternal pit; P.L.S., pleural suture; PRCX, precoxale; S, suture between meso- and metasternum; SL, sternellum; SP.2, metathoracic spiracle; S.P.S., sternopleural suture; S.S., sternal suture),  $\times 50$ . — Fig. 25 : Meso- and metasternum, inner view (C.R., chitinous rod; FU.2, mesothoracic furca; M.R., median ridge; P.L.R., pleural ridge; S.R., sternal ridge; other lettering as in Figure 24),  $\times 31$ . — Fig. 26 : Mesocoxa (CX, coxa; FM, basal part of femur; TR, trochanter),  $\times 50$ . — Fig. 27 : Right elytron, inner view (AP, apophysis; AR, articular surface; EPI, epipleuron; GL, elytral glands),  $\times 31$ .



yoke plates described by Snodgrass (1908), from the mesothorax of *Calosoma scrutator* F., and which serve to yoke the mesonotum to the metanotum.

Internally, the cephalic and lateral margins of the scutum (Fig. 23, SCT) are flexed over the convex dorsal surface, to form a pocket-like structure for the attachment of muscles.

The mesopleuron (Figs. 24 and 25) lies for the most part on the ventral side. The episternum (EPS) is nearly rectangular in form, and is disposed somewhat obliquely, with its anteriormost part curving dorsally. The episternum (EPS) is separated from the mesosternum by a distinct sternopleural suture (Fig. 24, S.P. S.), and from the epimeron (EPM) by the pleural suture (PL.S.), which is the external manifestation of the pleural ridge (Fig. 25, PL.R.). The apex of the dorsally extended part of the episternum (Figs. 24 and 25, EPS) is concave and carries two apodemal processes. The dorsal process of these two, is the alifer or pleural (ventral) wing process (Ö), which supports the elytron. The other apodemal process (A) is somewhat large in size, and is attached to the mesotergum by means of a ligament. The epimeron (EPM) is nearly triangular in form, with the apex lying between the posterior angle of the episternum (EPS) and the antero-lateral edges of the metasternum. The epimeron (EPM) possesses a longitudinal carina, which divides it into two parts, an outer lateral part, and an inner ventral part. In the membrane beneath the latter, opens the mesothoracic spiracle (SP. 2.). From the epimeron (EPM) a longitudinal slender sclerotized projection, extends backwards along the lateral margin of the metasternum, and fuses with it (Fig. 25). The episternum and the epimeron complete the boundary of the coxal cavity laterally, where their inner corners form an acetabulum, into which fits a condyle on the apical end of the mesocoxa. The pleural ridge (Fig. 25, PL.R.) is broad anteriorly and tapers posteriorly. The ridge is bent over the episternum forming a pocket-like structure.

The mesosternum (Figs. 24 and 25) is composed of a T-shaped sclerite "the basisternum", and the furcasternum. The basisternum (BS. 2) extends anterior to and in between the mesocoxae. The part of the basisternum, anterior to the coxa, is the precoxale (Fig. 24, PRCX). This (PRCX) is separated from the mesopleuron by the sternopleural suture (S.P.S.). In the middle, towards the anterior end, the basisternum (BS. 2.) has a triangular pit (P) into which the sternal process of the prosternum (Fig. 17, BS.P.) is inserted. Just posterior to the pit, a transverse carina extends between the anterior ends of the coxal cavities. The carina divides the basisternum into a less chitinized anterior portion, which is at a slightly dorsal level than the posterior portion. This latter is much chitinized and lies in between the coxal cavities. The furcasternum (FS.2.) is a concave



sclerite, lateral to the posterior portion of the basisternum (BS. 2): It extends laterally and reaches the episternum (EPS) and epimeron (EPM). In the furcasternum (FS. 2) fits the coxa of the mesothoracic leg. The two furcasterna of both sides are connected together internally with a transverse well chitinized rod (Fig. 25, C.R.). The furcal pit (Fig. 24, FP. 2) is small and rounded, while the furca (Fig. 25, FU. 2) is in the form of a slender rod, which curves upwards and outwards, and is inserted on the middle part of the pleural ridge (PL.R.). The trochantin of the mesothoracic pleuron is totally absent.

#### *Chaetotaxy of the mesothorax*

The mesothoracic tergum is nearly naked. The posterior margin of the scutum (Fig. 22, SCT) has a few setae. The episternum and epimeron (Figs. 24 and 25, EPS and EPM) are also provided with setae, which become comparatively long on the margin of the latter. The anterior margin of the basisternum (BS. 2) has a row of short spines, while a few scattered setae occur on its posterior portion.

#### *Mesothoracic leg*

The mesothoracic leg. (Fig. 26) resembles in its essential features the prothoracic leg already described. It only differs in that the side of its coxa is smaller than that of the prothoracic or the metathoracic legs. It is rounded in form, and with a condyle at its apex, which articulates with the mesopleuron.

#### *Elytra*

Each elytron (Fig. 27) is a wide convex structure, when viewed from above. It is heavily chitinized, with a broad declivous base. It tapers downwards abruptly into the apophysis or basal process (AP.). The two elytra together, completely cover the mesothorax, the metathorax and the abdomen, only leaving the last abdominal segment, uncovered. The epipleuron (EPI) is broad in front and tapers posteriorly. It fits closely against the latero-ventral angles of the thorax and abdomen.

On the ventral surface of the outer and inner margins of the elytron, there are rows of apertures (GL). These in the epipleuron (EPI) extend from the upper to the lower surface, as vertical canals, which open on the lower or ventral surface. Similar apertures are also found in large numbers, irregularly distributed on the ventral surface of the posterior end of the elytron. These openings seem to be the apertures of the glands called by Tower (1903) "elytral glands". Similar glands were also described from the elytra of adult Chrysomelidae, by Bruneteau (1927) and Patay (1937).

Minute bristles cover the whole surface of the epipleuron (EPI).

*Basal articulation of the elytron*

The produced articulatory arm or apophysis (Fig. 27, AP), at the base of the elytron, is supposed by Berlese (1909) to represent the heads of the costa, the subcosta, the radius, the media, the cubitus and the third anal veins fused together (Jeannel 1925), while by other authors it is supposed to represent the heads of the costa, the subcosta and median veins fused together. The apophysis (AP) is in the form of a triangular process at the antero-medial margin of the ventral aspect of the elytron. Below the apophysis (AP), and towards the median line, is an oval concavity (AR), which was called by Jeannel (1925) "the articular surface".

The articulating sclerites of the elytron were not fully described by previous authors in Coccinellidae. They are complicated in structure (Fig. 23) and are not quite identical with those of the hind wings. Their relative position is also different.

The articular sclerites are seven in number. The first sclerite (Fig. 23, 1) which may be compared with the first axillary sclerite) is small, triangular and is obliquely disposed in the alar membrane. Its apex articulates with the anterior notal wing process of the prescutum (A.N.P.). The base of this sclerite fits on the upper surface of the apophysis of the elytron (Fig. 27, AP). The second sclerite (Fig. 23, 2) is curved with its outer surface, resting on the ventral surface of the apophysis (Fig. 27, AP). Its distal end fits in the concavity of the lateral margin of the mesonotum (Fig. 23, SCT). This sclerite articulates posteriorly with the third sclerite (3). This latter has its proximal end articulating with the posterior notal wing process (P.N.P.). Its distal end is bifurcated and forms two processes, the anterior process articulates with the fifth sclerite (5), which is comparatively large in size. These two sclerites, that is the third and the fifth, are strongly connected to the anterior apodeme of the episternum, the pleural wing process (Figs. 24 and 25, O), by means of a ligament. The posterior process of the third sclerite (Fig. 23, 3) is attached to the fourth sclerite (4), which is strongly curved and nearly semi-circular in form. It has its distal end attached to the median base of the apophysis (Fig. 27, AP), near the articular surface (AR). Its curved body fits into the concavity of the articular surface of the elytron (AR). The distal arm of the sixth sclerite (Fig. 23, 6) is attached to the seventh sclerite (7), while its proximal end is attached to the fifth sclerite (5). The seventh sclerite (7) is broad and wing-shaped. Its distal end is attached to the membrane at the inner and ventral angle of the mesepimeron, near the metathoracic spiracle (Figs. 24 and 25, SP. 2).

*c. Metathorax*

The metathorax is the largest and the most developed segment of the thorax. The metatergum is situated more forward than the metasternum, so that its middle part lies dorsal to the mid-coxa.

The metatergum (Figs. 28 and 29) is composed of the notum and the postnotum. The former is dorsally convex and is connected to the latter by a membrane.

The notum is composed of the three usual sclerites, that is the prescutum, the scutum and the scutellum.

The prescutum (Figs. 29 and 30, PRS) is the anterior transverse sclerite, which is narrow in the middle and broadens towards the sides. Anteriorly, the margins of the prescutum (PRS) project into the body cavity forming the prephragma (Fig. 30, 1.PH.). This is laterally produced into two pointed arms "the lateral arms of the prephragma" (1.PH.A.) of some authors. On the prephragmatal arms are inserted the yoke plates of the mesotergum (Fig. 22, PN.A.). The posterior margin of the prescutum (Figs. 28, 29, and 30) merges into a soft membranous area (MB), which connects it to the scutum. This membranous area is bounded anteriorly by the prescutum (PRS) laterally by the anterior lobe of the scutum (A.SCT.) and posteriorly by the anterior transverse suture (Figs. 28 and 30, N).

The scutum (Figs. 28 and 29) is divided into two lateral separate parts by the scutellum (SCL), each of which is separated from the latter by an oblique scuto-scutellar suture (Fig. 28, V.S.). Internally this suture is represented by a broad ridge which is termed by Snodgrass "the scuto-scutellar ridge or entodorsum" (Fig. 29, VS.R.). Each part of the scutum is divided into two lobes by a semicircular intrascutal suture (Figs. 28 and 29, JJ). The antero-lateral lobe (A.SCT.) forms the anterior and antero-lateral regions of the notum, and is continuous laterally with the costal area of the wing. From the antero-lateral angle of this lobe arises the anterior notal wing process (A.N.P.) (suralar of Crampton 1926), to which the anterior margin of the first axillary sclerite (A.I.) is attached. Internally the anterior scutal lobe is folded into a pocket-like structure (Fig. 29, A.SCT.) for the attachment of muscles. To the anterior end of this lobe, is attached the anterior muscle disc of the notum (M.D.). The posterior lobe of the scutum (Figs. 28, 29, and 30, P.SCT.) is somewhat towards the middle of the notum, close to the scutellum (SCL). It is well chitinized and from its postero-lateral angles, projects the broad and triangular posterior notal wing process (P.N.P.), to which is attached the posterior arm of the third axillary sclerite (Fig. 29, A. 3). Between the anterior notal wing process (A.N.P.) and the posterior notal wing process (P.N.P.), the notum is laterally invaginated (Fig. 29, C).

The scutellum (SCL) lies in the middle of the notum. It has its median part slightly depressed to form the median groove (M.G.), into which fits the thickened inner edges of the elytra. The sides of the scutellum (SCL), are formed by two sclerites, each is triangular in shape, and is separated

from the posterior scutal lobe (P.SCT) by the scuto-scutellar suture (V.S.). Both the scutum and scutellum are bounded anteriorly by the transverse anterior suture (Fig. 28, N), which is the external manifestation of the

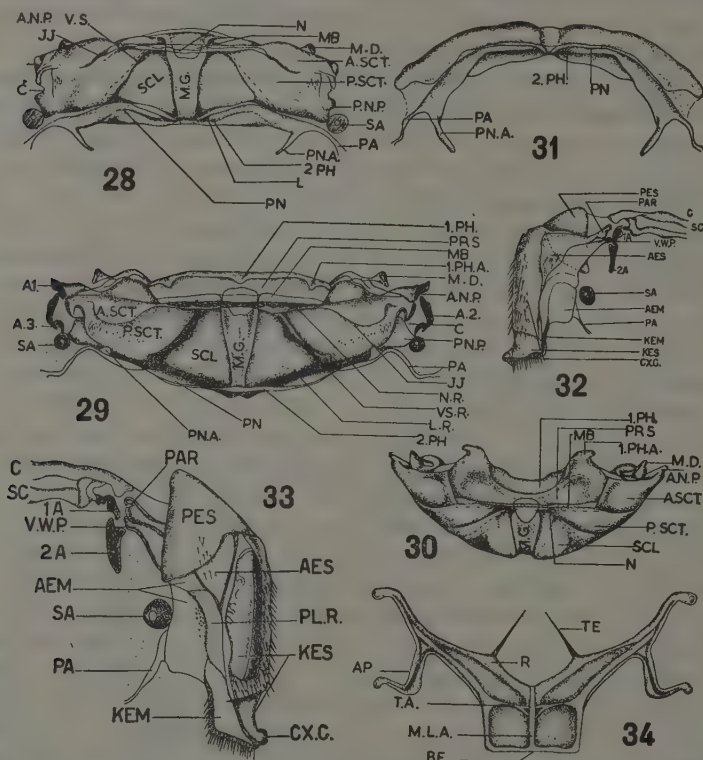


Fig. 28 : Metatergum, outer view (A.N.P., anterior notal wing process; A.SCT., anterior scutal lobe; C, invagination between anterior and posterior notal wing processes; JJ, transverse intrascutal suture; L, posterior marginal suture; MB, membrane; M.D., muscle disc; M.G., median groove; N, transverse anterior suture; PA, postalare; 2.PH., postphragma; PN, postnotum; P.N.A., postnotal arm; P.N.P., posterior notal wing process; P.SCT., posterior scutal lobe; SA, subalare; SCL, scutellum; V.S., scutoscuteal suture),  $\times 50$ . — Fig. 29 : Metatergum (inner view) : A. 1, first axillary sclerite; A.2, second axillary sclerite; A.3, third axillary sclerite; L.R., posterior marginal ridge; N.R., transverse anterior ridge; 1.PH., prephragma; 1.PH.A., lateral arm of prephragma; PRS, prescutum; V.S.R., scutoscuteal ridge; other lettering as in Figure 28),  $\times 50$ . — Fig. 30 : Metatergum, anterior view (lettering as in Figures 28 and 29),  $\times 50$ . — Fig. 31 : Metatergum, posterior view (lettering as in Figure 28),  $\times 50$ . — Fig. 32 : Metapleuron, inner view (1A, first axillary sclerite; 2A, second axillary sclerite; AEM, anepimeron; AES, anepisternum; C, costa; CX.C., coxal condyle; KEM, katapimeron; KES, katapisternum; PA, postalare; PAR, basalare; PES, preepisternum; PL.S, pleural suture; SA, subalare; SC, subcosta; V.W.P., ventral (pleural) wing process),  $\times 31$ . — Fig. 33 : Metapleuron, outer view (P.L.R., pleural ridge; other lettering as in Figure 32),  $\times 50$ . — Fig. 34 : Metafurca (AP, apophysis; B.F., base of furca; M.L.A., median longitudinal ridge; R, rib; T.A., transverse ridge; TE, tendon),  $\times 50$ .



transverse anterior ventral ridge (Fig. 29, N.B.). Posteriorly, they are bounded by the posterior marginal suture (Fig. 28, L), which is the outward indication of the posterior marginal ridge (Fig. 29, L.R.).

The postnotum (Figs. 28, 29, and 31, PN) is a transverse sclerite lying posterior and at right angle to the notum. Its posterior margin carries the postphragma (2. PH.). Laterally the postnotum (PN) has two processes on each side, the inner process, the postnotal arm (PN.A.), is prominent and projects into the body cavity for the attachment of muscles. The outer process, the postalar bridge or postalare (PA), is more slender and curves downwards and is connected to the posterior margin of the anepimeron (Figs. 32 and 33, AEM).

The pleuron of the metathorax (Figs. 32 and 33) is composed of the two usual sclerites, the episternum and the epimeron, separated by the pleural suture (Fig. 32, PL.S.). The episternum is divided into a ventral part, the katepisternum (Figs. 32 and 33, KES), and two lateral parts, the anepisternum (AES) and the pre-episternum (PES). The epimeron is divided into the katepimeron (KEM) and the anepimeron (AEM). The katepisternum (KES) runs parallel to the lateral margin of the metasternum, and its posterior end projects beyond the latter to articulate with the metacoxa. This sclerite is divided into two halves, at right angle to each other, by means of a longitudinal carina. The part which is nearer to the sternum is heavily chitinized and densely covered with long setae. The other half is less chitinized and without setae. The anepisternum (AES) is nearly triangular in form and lies in the anterior region of the metapleuron. The anterior parapterum or basalare (PAR), which supports the humeral angle of the wing from beneath, near the head of the costal vein, is fused with the anepisternum (AES). The pre-episternum (PES) is a triangular well chitinized sclerite, with most of its posterior region covered by the anepisternum (AES).

The katepimeron (KEM) is a flattened, strongly chitinized sclerite lying close to the posterior edge of the katepisternum (KES). The two form a condyle (CX.C.), which fits into an acetabulum in the hind-coxa. The anepimeron (AEM) is a weakly chitinized sclerite, with its posterior end connected to the postnotum of the metathorax by the postalar bridge or postalare (PA). The anterior ends of the epimeron and episternum project dorsally to form the pleural or ventral wing process (V.W.P.), which articulates with the anterior arm of the second axillary sclerite (2A). The anepimeron (AEM) is connected dorsally to the metascutum by a membrane, in which is embedded a small round muscle disc, the subalare (SA). Internally the pleural ridge (Fig. 33, PL.R.) is distinctly narrow in front and broad towards its posterior end.



The metasternum (Figs. 24 and 25) is a flattened convex sclerite. It is the largest of the three thoracic sterna. The basisternum (BS. 3) forms the most part of the metasternum, and is separated from the narrow and transverse posterior sternellar sclerite (SL) by the sternal suture (Fig. 24, S.S.) (Snodgrass 1935).

The metasternum is separated from the mesosternum by a transverse suture (S), which extends in between the mesocoxae. Laterally behind the mesocoxal cavities, the antero-lateral margin of the basisternum is deeply concave, and forms the posterior boundaries of the mesocoxal cavities. Behind each mesocoxal cavity, there is a concavity in the antero-lateral part of the basisternum (BS. 3). Into this concavity (mesocoxal plate of Sweetman 1930) the mesothoracic leg fits, when it is folded beneath the body.

The basisternum (BS. 3) is divided longitudinally by the median suture (Fig. 24, M.S.), which runs along the posterior two thirds of the basisternum. This suture is the external indication of a prominent vertical ridge (Fig. 25, M.R.), which lies opposite to the longitudinal ridge of the metathoracic furca (Fig. 34, M.L.A.). The epimeron of the mesopleuron (Fig. 25, EPM) is firmly connected with the metathoracic sternum by a slender sclerotized rod, along the lateral margin of the metathoracic basisternum (Fig. 25).

The posterior transverse sclerite of the metasternum, the sternellum (Fig. 24, SL), is separated from the basisternum (BS. 3) by the sternal suture (S.S.). Its median part carries the furca and is called the furcasternum (sternellar piece of some authors) (Figs. 24 and 25, FS. 3), the rest forms the sternellar sclerites of Snodgrass (1935) or the precoxale of Sweetman (1930) and other authors. The furcasternum (FS. 3) is a semicircular sclerite which is deeply invaginated posteriorly. Into this invagination fits the intercoxal process of the third abdominal sternum (Figs. 39 and 40, I.CX.P.). To the posterior dorsal edge of the furcasternum (Fig. 25, FS. 3) articulates the furca (Fig. 34). On the postero-lateral corner of the furcasternum (Figs. 24 and 25, FS. 3), on each side, there is a small concavity, in which fits a small condyle on the inner or distal end of the metacoxa. The sternellar sclerites (SL), which lie little dorsal to the basisternum (BS. 3) are somewhat narrow, with angular sides. Below these, the posterior ends of the katepisternum and katepimeron project and articulate with the metacoxa.

The whole surface of the basisternum (BS. 3) and sternellum (SL) is covered with long setae, which become numerous on the sides.

The metafurcasternum or the metendosternite of Crowson (1938 and 1944) (Fig. 34) is nearly trapezoidal in shape, with its antero-lateral ends extending forwards to form "the arms of the furca" (Crowson 1938 and 1944). These arms meet the ventrally projecting postnotal arms of the

metapostnotum (Fig. 31, PN.A.). Arising from the middle of each arm is a large curved apodeme or apophysis (AP), which extends posteriorly. The base of the furca (B.F.) is somewhat broad and articulates with the dorsal edge of the metafurcasternum. The furca is divided by a longitudinal median suture into two lateral equal halves. This suture is represented ventrally by a prominent ridge (M.L.A.), which lies opposite to the median ridge of the metathoracic basisternum (Fig. 25, M.R.). At right angle to the median suture, and extending transversely in the middle of the furca, there is another transverse suture which is also represented internally by a ridge (Fig. 34, T.A.). The front or distal margin of the furca is much thickened and forms the rib (Crowson 1938 and 1944) (R). This supports two slender delicate structures called tendons (TE), by the same author.

### Hind leg

The hind leg (Fig. 35) is exactly similar to the mesothoracic leg except that its coxa is larger. The coxa is roughly triangular in shape. It has an

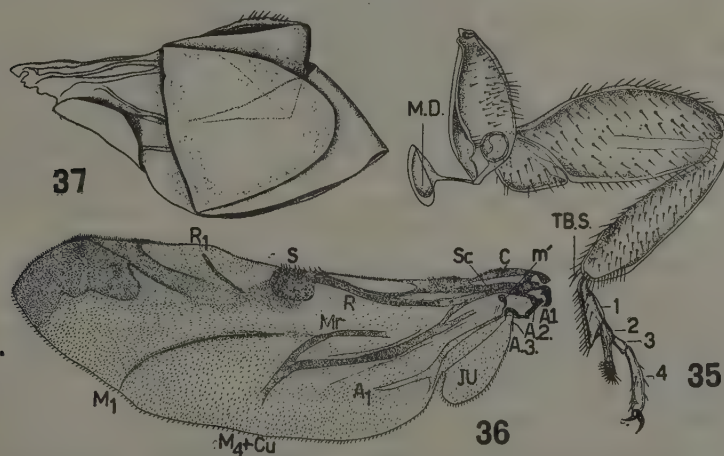


Fig. 35 : Hind-leg (M.D., muscle disc; TB.S., tibial spur; 1-4, tarsal joints),  $\times 50$ . — Fig. 36 : Left wing (A.1-3., axillary sclerites; JU, jugum; m', distal median plate of the base of the wing; S, pterostigma),  $\times 31$ . — Fig. 37 : Left wing folded,  $\times 31$ .

acetabulum and a condyle, the former lies on its outer or proximal end and articulates with the coxal condyle (Figs. 32 and 33, CX.C.) on the metapleuron, while the latter lies on its inner or distal end, and articulates with the metafurcasternum. Attached to the inner or distal end of the coxa, there is a large muscle disc (M.D.).

*Hind wing*

The wing (Fig. 36) is connected to the body by means of the alar membrane, strengthened by the axillary sclerites.

The hind wing is membranous in texture, folded transversely and longitudinally, over the metathorax and abdomen beneath the elytron. The venation is distinctly reduced.

The characteristic feature of the wing is that the main veins have migrated forwards, towards the costal margin. The costa (C) lies along the costal edge of the wing, and has its proximal end strongly curved. It extends along the proximal half of the anterior margin of the wing, fusing on a part of its course with the subcosta (Sc), and ending into the pterostigma (S). The second vein or the subcosta (Sc) is more slender at its base, where it is connected with the head of the first axillary sclerite (A. 1). Near the wing base the humeral cross-vein extends from the costa (C) to the subcosta (Sc).

After a short distance from the base of the wing, the subcosta (Sc) fuses with the costa (C), then it separates from it and runs close to the radius (R) till it merges at last into the pterostigma (S).

The radius (R) is basally articulated with the anterior end of the second axillary sclerite (A. 2). For most of its course, the radial vein (R) runs close to the subcosta (Sc) and similarly merges into the pterostigma (S). From the several branches of the radius,  $R_1$  is the only branch which is represented. It has lost its connection with its main stem, and is found near the costal margin, just behind the pterostigma (S), towards the apex of the wing.

The media is represented only by a recurrent vein "Mr", which has lost its basal connection.  $M_1$  is represented as a separate branch. The branch  $M_4$  has coalesced with the cubitus "Cu", forming a single branch  $M_4 + Cu$  which does not reach the wing margin. The anals are greatly atrophied, and are represented by A, which forks posteriorly.

Distal to the pterostigma (S), and towards the apex, the wing has an oblique concave area which is darker in colour than the rest of the wing. Also the apex of the wing has a roughly triangular and dark pigmented area.

*Chaetotaxy and distribution of vesicles on the wing*

Numerous minute hairs or microtrichia are distributed all over the surface of the wing. The entire margin of the wing is fringed with bristles. The costa (Fig. 36, C) possesses two groups of setae near its base, and the pterostigma (S) is also provided with a row of strong setae at its anterior margin.

Besides the bristles, there are round prominent bodies or vesicles with double edges. These are distributed mainly on the costa (C), the subcosta

(Sc), the radius (R) and the pterostigma (S). According to Jackson (1928) (El-Sayed 1940), these vesicles are of unknown function.

#### *Basal articulation of the hind wing*

The wing (Fig. 36) is articulated with the tergum by means of the axillary sclerites. These are three in number, the first (A.1) is a small sclerite which articulates at its inner or proximal margin with the anterior notal wing process (Figs. 28 and 29, A.N.P.). Its anterior end is slightly hooked and articulates with the subcosta (Fig. 36, Sc), while the posterior end articulates with the second axillary sclerite (A.2). This latter sclerite is the largest of the three. Its anterior end is forked into two arms, an arm is attached to the first axillary sclerite (A.1), while the other arm projects ventrally to rest on the metapleural wing process (Figs. 32 and 33, V.W.P.). The posterior end of the second axillary sclerite is connected to the third axillary sclerite (Fig. 36, A.3). This (A.3) is a transverse sclerite, with its proximal end articulating with both the posterior notal wing process (Figs. 28 and 29, P.N.P.) and the second axillary sclerite (Fig. 36, A.2). Its distal end is attached to the anal vein (A<sub>1</sub>).

Distal to the second and third axillary sclerites, and at the base of the medio-cubital area, is a small semicircular chitinized sclerite (m'), which may represent the distal median plate of the wing.

The folding of the wing is very simple, and it follows the lines of least resistance. Figure 37 shows clearly the left wing folded, as seen in a ventral view.

#### **4. The abdomen**

Eight abdominal terga are visible (Fig. 38), in both the male and the female. Of these the anterior seven terga are normally covered with the elytra. The first abdominal tergum (T. 1), is connected to the metathoracic tergum, and is entirely membranous. The second tergum (T. 2) shows weak chitinization in its lateral and posterior regions. The abdominal terga of segments three to five (T.3, T.4, and T.5) are more chitinized than those of the preceding segments, and are connected together with large inter-segmental membranes. The terga of segments six to eight (T.6, T.7, and T.8) are more chitinized, and each is connected internally with the preceding one by means of two forwardly directed processes on both sides of the segment. The eighth abdominal tergum (T.8) is well developed and convex dorsally. It is shield-like, setiferous, broad at its base and with a more or less pointed distal end. It covers completely the internally retracted ninth and tenth abdominal segments.

The abdominal pleura (Fig. 38) are apparently six in number. The first of these, is membranous, and is continuous with the metapleuron anteriorly.



On the anterior five pleura (PL. 1-5) open the five pairs of abdominal spiracles (SP. 1-5). The areas round the second, third, fourth and fifth pairs of spiracles are more chitinized than the rest of the plera, which are completely membranous. The seventh and eighth abdominal pleura are more or less reduced to narrow membranes, which connect the seventh and eighth abdominal terga with the corresponding sterna.

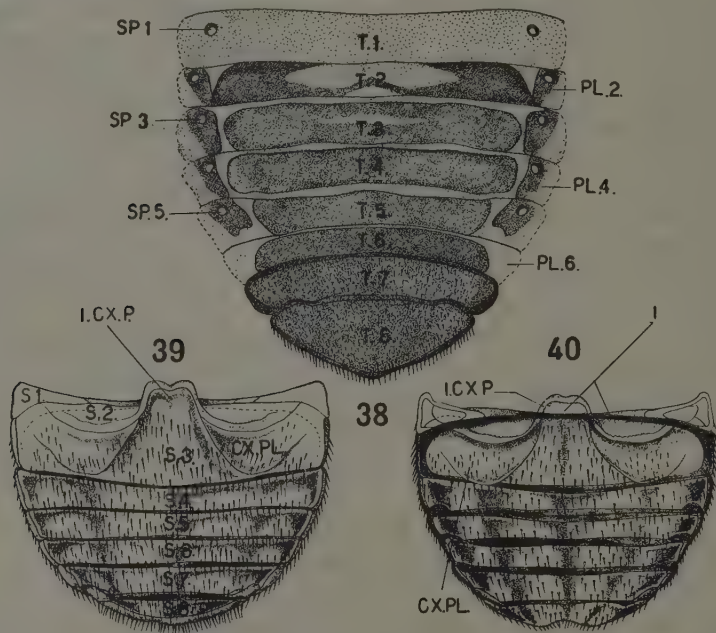


Fig. 38 : Abdominal terga and pleura (PL. 2-6, abdominal pleura; SP. 1-5, abdominal spiracles; T. 1-8, abdominal terga),  $\times 31$ . — Fig. 39 : Abdominal sterna of the female, outer view (CX.PL., metacoxal plate; I.CX.P., intercoxal process; S. 1-8, abdominal sterna),  $\times 31$ . — Fig. 40 : Abdominal sterna of the male, inner view (lettering as in Figure 39),  $\times 31$ .

The eight abdominal sterna, except the first two, are well developed and more strongly chitinized (Figs. 39 and 40). The first two sterna (S.1 and S.2) are divided each into two parts, by the anteriorly produced intercoxal process (I.CX.P.) of the third sternum (S.3). Each division of the first sternum (S.1) is in the form of a triangular sclerite, which lies anteriorly on the side of the abdominal sterna. Each division of the second abdominal sternum (S.2) is less chitinized than that of the first sternum (S.1), and extends between the apex of the latter sternum (I.CX.P.). These



sternal sclerites, on either side, are normally hidden by the coxa of the metathoracic leg.

The third abdominal sternum (S.3) is the largest of all the abdominal sterna. It is concave along its anterior margin, on either side of the intercoxal process (I.CX.P.), and forms the posterior boundaries of the metathoracic coxal cavities. Posterior to the coxal cavities, the third sternum (S.3) is slightly concave and forms the metacoxal plates (CX.PL.). The intercoxal process (I.CX.P.) is a forward projection of the median part of the third sternum (S.3). It fits into the invagination of the metathoracic furca-sternum (Figs. 24 and 25, F'S. 3). The intercoxal process (Fig. 40, I.CX.P.) is internally or dorsally flexed and forms a pocket-like structure for the attachment of muscles.

The sterna four to seven (S. 4-7) are nearly of the same shape and size. The eighth sternum (S. 8) differs in both sexes; in the female, the posterior or distal edge of the eighth abdominal sternum (Fig. 39, S. 8) is somewhat rounded, while in the male it is notched in the middle (Fig. 40). This morphological difference can be made use of, in differentiating between the two sexes.

The abdominal sterna, except the first two, are covered with numerous setae.

## Genitalia

### *Genitalia of the female*

The female genitalia (Figs. 41 and 42) are simple and are retracted within the eighth abdominal segment, with which they are connected by membrane.

According to Tanner (1927), the female genitalia of the Coccinellidae consist of the proctiger, paraprocts (<sup>1</sup>), valvifers, coxites and styli.

The proctiger (Tanner 1927) (PP) is a well chitinized, more or less tetragonal sclerite, which lies below the eighth tergum. Beneath the proctiger (PP) opens the anus (Fig. 42, AN). The paraprocts (Figs. 41 and 42, VF) are situated on the sides of the proctiger (PP), and they extend over the pleural region of the ventral side (Fig. 42, VF). The coxites (CX) form the ventral part of the genitalia. Each coxite (CX) is roughly triangular in shape and slightly concave from its dorsal side. Its median and posterior margins are provided with thick lips. Between the two coxites opens the female genital aperture or vulva (VUL). The styli are absent.

According to Tanner (1927), the proctiger (PP) is the tergum of the tenth abdominal segment, while the sternum is totally absent. The ninth

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(<sup>1</sup>) This part is termed surstylus by Crampton (1929).

tergum is membranous and folded beneath the eighth tergum, connecting the latter with the proctiger (PP). The appendages of the ninth segment are the coxites (CX). The paraprocts, according to the same author, may be a part of the ninth tergum.

The posterior ends of the proctiger, the paraprocts and the coxites are fringed with numerous long setae.

#### *Male genitalia*

According to Sharp and Muir (1912) the aedeagus (Fig. 45) is composed of the median lobe and the tegmen. These lie in the abdominal cavity, below the alimentary canal on the left side. The median lobe (Figs 45 and 46, ML) is a curved structure extending nearly from the third to the eighth sterna. It is a long and slender tube, which expands at the base to form an apodeme (A), for muscle attachments. The wide opening at the base of the median lobe (ML) is the median foramen (M.F.), through which the continuation of the ejaculatory duct (Fig. 62, DEJ) runs inside the median lobe (ML) as the internal sac (IS). The median orifice (Fig. 46, M.O.), which lies at the distal extremity of the median lobe (ML) is small and oval, and is guarded with fine rows of minute spines.

The tegmen (Figs. 45 and 47) surrounds the median lobe (ML) completely. It is composed of the basal piece (BP), the lateral lobes (LL) and the basal lobe (BL). The basal piece (BP) is a cup-shaped structure, completely surrounding and supporting the aedeagus. It is weakly chitinized with a thickened anterior edge. Attached to the right side of the basal piece (BP), in the middle, is the median strut (MS). It is a well chitinized rod, with a broad round apex, which rests on the upper surface of the transverse apodeme (A) of the median lobe (ML), and which is attached to it by muscles. Just below the base of the median strut (MS), there is a small rounded membranous sac (SAC), which is attached to the tegmen at the base of the basal lobe (BL). It has a round foramen in the middle of its left side, through which passes the median lobe (Fig. 45, ML). Such membranous sac has not been described by previous authors.

The lateral lobes or the parameres (Figs. 45 and 47, LL) are attached to the lateral ends of the basal piece, while the basal lobe (BL) arises from the median part of the basal piece (BP), in between the lateral lobes (LL).

The lateral lobes (Fig. 47, LL) are slightly shorter than the basal lobe (BL), and their rounded distal margins carry few long setae. The basal lobe (BL) is grooved along its entire length, and with a sharply pointed end. It is also produced on the left side, near the middle, into a small triangular tooth-like process.

The spicule (Fig. 45, SP) is a ventral slender rod, attached to the median ventral membranous part of the ninth segment. Its distal end is

slightly curved. This spicule is considered by some authors (Sharp and Muir 1912) to represent the ninth sternum. It is not a part of the aedeagus, but it serves as an apodeme for the attachment of muscles.

The tegmen is surrounded by a membrane "the second connecting membrane" (Fig. 45, CM. 2), which connects it to the termination of the abdomen (Sharp and Muir 1912). The first connecting membrane (CM.1) is long and completely covers the median lobe (ML).

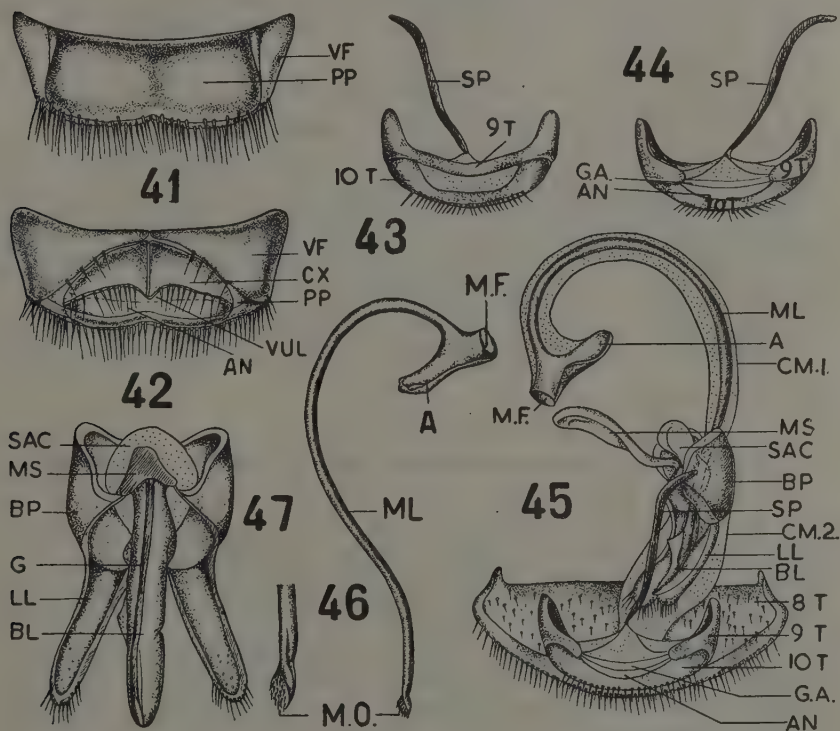


Fig. 41 : Genitalia of the female, dorsal view (PP, proctiger; VF, paraproct),  $\times 75$ . — Fig. 42 : Genitalia of the female, ventral view (AN, anus; CX, coxite; PP, proctiger; VF, paraproct; VUL, vulva),  $\times 75$ . — Fig. 43 : Male genitalia, dorsal view (SP, spicule; 9T and 10T, ninth and tenth abdominal terga),  $\times 46$ . — Fig. 44 : Male genitalia, ventral view (AN, anus; G.A., male aperture; SP, spicule),  $\times 46$ . — Fig. 45 : Aedeagus of the male (A, transverse apodeme of median lobe ML; AN, anus; BL, basal lobe; BP, basal piece; CM.1 and CM.2, first and second connecting membranes; G.A., genital aperture; LL, lateral lobe; M.F., median foramen; MS, median strut; SAC, membranous sac; SP, spicule; 8T, 9T and 10T, eighth, ninth, and tenth terga),  $\times 46$ . — Fig. 46 : Median lobe (A, transverse apodeme of median lobe ML; M.F., median foramen; M.O., median orifice),  $\times 75$ . — Fig. 47 : Tegmen with the median strut cut at its base (G, groove in the middle of the basal lobe into which runs the median lobe; other lettering as in Figure 45),  $\times 75$ .

Associated with the male genitalia are the ninth and the tenth abdominal segments (Figs. 43 and 44), which are retracted within the abdominal cavity. The ninth tergum (9 T) is a ring-like sclerite which extends on the ventral side. The ninth sternum is completely membranous (Fig. 44), and to its median part is attached the spicule (SP) (considered by Sharp and Muir 1912 as the sternum). Below the ninth segment opens the male genital aperture (G.A.). The tergum of the tenth segment (Figs. 43 and 44, 10T) is distinct and well chitinized, while the sternum is completely absent. Below the tenth tergum opens the anus (AN).

#### IV. INTERNAL ANATOMY

##### 1. The alimentary canal

The alimentary canal (Fig. 48) begins from the preoral cavity, which is enclosed between the mouth-parts. Except for a small loop in the region of the ileum (IL), the alimentary canal is almost a straight tube, extending from the true mouth aperture, at the caudal end of the preoral cavity, to the anus, at the posterior end of the body.

The alimentary canal is divisible into the three usual main divisions, i.e. stomodaeum or fore-gut, mesenteron or mid-gut and proctodaeum or hind-gut.

##### a. Fore-gut

The first part of the fore-gut is the pharynx (PHY), which is a small conical muscular chamber, lying just in front of the supraoesophageal ganglion. Its anterior wide end forms the mouth aperture. Posteriorly the pharynx (PHY) leads to the oesophagus (OES). Attached to the side walls of the pharynx are the dilator muscles, which are inserted on different parts of the head capsule.

The oesophagus, the second division of the fore-gut, is a narrow muscular tube extending between the circum-oesophageal commissures. Where it reaches the anterior end of the prothorax, the oesophagus dilates and forms the crop (CR).

The crop (CR) is a conical small chamber, occupying the anterior half of the prothorax. It opens posteriorly into the mesenteron (MENT). Between the crop (CR) and the mesenteron (MENT) there is a constriction, which marks externally the position of the oesophageal valve.

##### b. Mid-gut or mesenteron

The mid-gut (Fig. 48, MENT) is the most important section of the alimentary canal. It extends from the middle of the prothorax to the anterior margin of the seventh abdominal segment. The diameter of the mesenteron is nearly five times that of the oesophagus, and much more than

that when it is filled with food. The mesenteron is wide in front and narrows gradually towards its posterior end, where it joins the pyloric end of the ileum (IL). Anteriorly the gastric coeca of the cardiac end of the stomach are morphologically not well defined. The wall of the mid-gut is ornamented by small roughly hexagonal areas, which are regularly distributed all over its surface. These areas are the nidi.

#### c. Hind-gut

The hind-gut or proctodaeum is composed of the ileum (IL), colon (CLN) and rectum (RECT).

The ileum (IL) is a short narrow tube, leading from the mesenteron (MENT) to the colon (CLN). It curves sharply forwards and towards the right side of the body cavity, thus forming a small loop with the mesenteron, then it turns clockwise and runs posteriorly, leading to the colon (CLN).

At the junction of the ileum (IL) with the mesenteron (MENT), there is a constriction "the pylorus" (PY), marking externally the pyloric valve, and round which arise the six malpighian tubes (M.T.).

The colon (CLN) is tubular in form, twice as long as the ileum (IL), with its posterior part dilated to form a conical chamber which leads to the rectum (RECT).

The rectum (RECT) is a straight muscular tube, slightly wider than the ileum (IL), and nearly equal in length to the colon (CLN). It opens to the exterior by the anus, which lies below the proctiger.

#### d. Gnathal glands

The gnathal glands are four pairs, all of which open at the bases of the mouth-parts. They are a pair of mandibular glands, a pair of maxillary glands, a pair of mandibulo-maxillary glands and a pair of labial glands.

Each mandibular gland (Fig. 49, MD. GL.), is in the form of a simple unbranched tube, mostly coiled and lying in the prothorax just below the pronotum. The gland enters the head where it opens at the base of the mandible of its side, near the origin of the adductor muscle (ADD).

The maxillary (Fig. 50, MX. GL.) and the mandibulo-maxillary glands (M.M.GL.) are similar in structure to the mandibular glands (Fig. 49, MD. GL.) and closely associate them. The former open near the inner angles of the cardines, between them and the labium, while the latter open between the bases of the mandible and maxilla of each side of the head.

The labial glands (Fig. 51, LB.GL.) are a pair of glandular masses, found below the hypopharynx (HYPH), and lying symmetrically on either side of the median axis of the labium (LB). Each of these glands opens on the side of the hypopharynx.



In addition to the above mentioned four pairs of glands, there are smaller masses in the head capsule, which are the antennal and the ocular glands. The former are found at the bases of the antennae (Fig. 52, ANT GL.), while the latter are found in the anterior angle of the eyes.

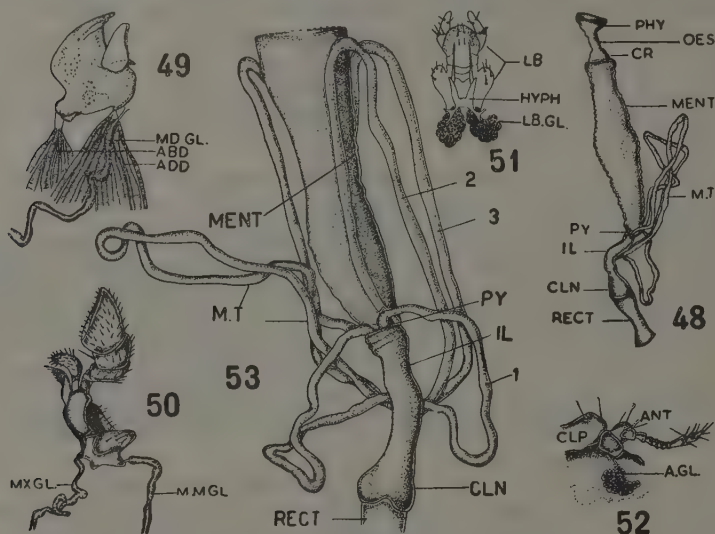


Fig. 48 : The alimentary canal of the adult, slightly stretched (CLN, colon; CR, crop; IL, ileum; MENT, mesenteron; M.T., Malpighian tubes; OES, oesophagus; PHY, pharynx; PY, pylorus; RECT, rectum),  $\times 31$ . — Fig. 49 : Right mandible with base of mandibular gland MD.GL. (ABD, abductor muscle; ADD, adductor muscle)  $\times 50$ . — Fig. 50 : Right maxilla with the base of mandibulo-maxillary (M.M.GL.), and the maxillary (MX.GL.) glands,  $\times 50$ . — Fig. 51 : Labium LB, with the labial glands LB.GL. (HYPH, hypopharynx),  $\times 50$ . — Fig. 52 : Antenna ANT, with the antennal gland A.GL. (CLP, clypeus),  $\times 50$ . — Fig. 53 : Malpighian tubes of the adult (CLN, colon; IL, ileum; MENT, mesenteron; M.T., Malpighian tubes; PY, pylorus; RECT, rectum; 1, dorsal Malpighian tube; 2, lateral Malpighian tube; 3, ventral Malpighian tube),  $\times 50$ .

As regards the function of these glands, it has been suggested, on structural grounds, that they secrete a liquid substance which may help in paralysing the prey (Pradhan 1939). This author added that this liquid substance is the same as that produced by the insect during reflex bleeding, a process which was described by McIndoo (1916).

## 2. The Malpighian tubes

The Malpighian tubes (Fig. 53) are six in number, symmetrically arranged round the pyloric annulus (PY), between the mid-gut and the hind-gut. Two of these are dorsal, two are lateral and two are ventral in position.

The dorsal tubes (1) are the shortest, while the ventral tubes (3) are the longest. While the dorsal tubes (1) directly run backwards, the lateral (2) and the ventral tubes (3) extend forwards in a zig-zag manner, to the meta- and mesothorax respectively. They then curve back towards the anterior end of the colon (CLN).

The three pairs of Malpighian tubes are retained close to the sides of the mesenteron (MENT) by the several tracheal branches which supply them. Their distal ends re-associate and invest the wall of the colon (CLN).

### 3. The central nervous system

The central nervous system (Figs. 54 and 55) is composed of the supra-oesophageal ganglion or brain, the suboesophageal ganglion and the ventral nerve cord.

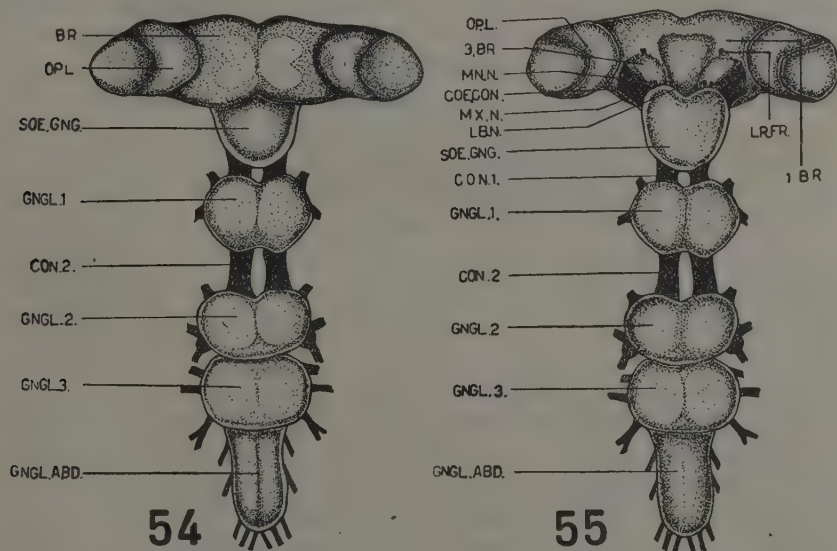


Fig. 54 : Central nervous system of the adult, dorsal view (BR, brain; CON.2, connective between pro- and mesothoracic ganglia; GNGL.1, 2, and 3, pro-, meso- and metathoracic ganglia; GNGL.ABD., abdominal ganglion; OPL., optic lobe; SOE. GNG., suboesophageal ganglion),  $\times 75$ . — Fig. 55 : Central nervous system of the adult, ventral view (1.BR., protocerebrum; 3.BR., tritocerebrum; COE.CON., circum-oesophageal connectives; CON.1, connectives between suboesophageal and prothoracic ganglia; LBN., labial nerve; LR.FR., labro-frontal nerve; MN.N., mandibular nerve; MX.N., maxillary nerve; other lettering as in Figure 54),  $\times 75$ .

The brain (Fig. 54, BR) occupies the posterior two thirds of the cranial cavity. It lies above the oesophagus and extends between the two compound eyes. It consists of the three main divisions, which are the protocerebrum (Fig. 53, 1. BR.), the deutocerebrum and the tritocerebrum (3. BR.)

The protocerebrum (1.BR.) is composed of two lobes which are completely fused together. It is a median transverse rectangular mass, occupying the median section of the brain. Its anterior margin is slightly depressed in the middle, indicating its bilobed origin. On either side of the protocerebrum (1.BR.) there is the optic lobe (OP.L.), which is a large subspherical swelling, continuous laterally with the inner ends of the ommatidia of the compound eyes.

The deutocerebral lobes lie on the antero-ventral part of the protocerebrum, from which they are not well defined.

The tritocerebrum (3.BR.) is represented by two well defined rounded lobes, lying each on either side of the postero-ventral part of the protocerebrum (1.BR.). From the sides of the tritocerebral lobes arise the broad circumoesophageal connectives (COE.CON.), which proceed ventrally downwards, round the oesophagus, and are connected to the antero-lateral ends of the suboesophageal mass (SOE.GNG.). From the anterior margin of the tritocerebral lobe (3.BR.) arises the labro-frontal nerve (LR.FR.), which soon divides into two nerves; the frontal ganglion connective and the labral nerve. The frontal ganglion connective is a very fine nerve, which runs on the sides of the pharynx for a short distance in front of the brain, and then curves towards the middle line, where it becomes connected to the small triangular frontal ganglion. This latter lies on the mid-dorsal surface of the pharynx. The labral nerve lies below the frontal ganglion connective, close to the pharynx, and extends forwards to supply the labrum.

The suboesophageal ganglion (SOE.GNG.), which is the ventral ganglionic mass of the head, is more or less oval and lies below the oesophagus, at the same level with the brain. It innervates the mouth-parts, by giving off at its anterior region, on either side, three nerves; the outermost is the mandibular nerve (Fig. 55, MN.N.), the innermost is the labial nerve (LB.N.), while the median is the maxillary nerve (MX.N.).

The ventral nerve cord is very short and extends only along the thoracic region, below the alimentary canal. It is highly specialized and is composed of three thoracic ganglia, together with an elongate mass of nerve tissue, which probably corresponds to the fused abdominal ganglia.

The prothoracic ganglion (Figs. 54 and 55, GNGL.1) lies in the middle of the prothorax. It is large, more or less spherical in form, and with two large nerve trunks arising on either side. It is connected anteriorly with the suboesophageal ganglion (SOE.GNG.) by a pair of short but stout commissures (CON.1), while posteriorly it is connected with the mesothoracic ganglion (GNGL.2) by another similar, but longer pair.

The mesothoracic ganglion (GNGL.2) is similar in shape, and slightly larger in size than the prothoracic ganglion (GNGL.1). It gives off on either side three nerves, of which the posterior two nerves originate by a short and stout common trunk. The meso- and the metathoracic ganglia are in close contact with each other and the connectives between them are absent.

The metathoracic ganglion (GNGL.3) lies in the front end of the metathorax, just posterior to the mesocoxal cavities. It gives off laterally three pairs of nerves.

The metathoracic ganglion (GNGL.3) is followed by an elongate mass of nerve tissue (GNGL. ABD.) which may correspond to the fused abdominal ganglia. It lies in the posterior region of the metathorax, and overlies the metafurca. It gives off several long and fine nerves which supply the different organs that lie in the abdominal cavity.

#### 4. The reproductive organs

##### a. Female reproductive organs

The female reproductive organs (Figs. 56, 57, and 58) are situated ventrally below the gut. They comprise the two ovaries, the two lateral oviducts, the median oviduct, the vagina and the spermatheca with its gland, duct and the bursa copulatrix.

Each ovary consists of a number of ovarioles (OVL), which varies from six to ten, although the usual number is eight. The ovarioles converge upon the anterior end of the corresponding lateral oviduct (ODL). The terminal part of each ovariole is the terminal filament (Fig. 59, T.F.). The terminal filaments of the ovarioles of each ovary unite to form the suspensory ligament (Fig. 57, LG), which is attached dorsally to the anterior end of the metatergum, on one side of the aorta.

Each ovariole (Fig. 59) consists of the terminal filament, the egg tube, and the pedicel. The terminal filament (T.F.), which is a part of the suspensorial apparatus of the ovary, is a fine thread arising from the anterior end of the ovariole.

The egg-tube (E.T.), which forms the second division of the ovariole, is the largest and the most important part of the ovariole. It consists of the germarium (GER) and the vitellarium (VTL). The germarium (GER) is the terminal chamber of the ovariole, lying below the terminal filament (T.F.). It is more or less cylindrical in form and granular in nature. It contains the oogonia and the trophocytes or nutritive cells. The germarium (GER) is followed by the vitellarium (VTL), which is larger in size, and is divided into a series of egg-chambers or follicles that contain the developing oocytes (OOC). Of these the more distant from the germarium (GER)

are larger and more mature. The ovariole is of the acrotrophic type, as the nutritive cells are restricted to the germarium (GER).

Each ovariole is connected to the corresponding lateral oviduct by the pedicel (PDCL). This is comparatively long in the young ovariole, which does not contain mature oocytes (Fig. 56), while it is much shorter and nearly indistinct in the ovariole which contains mature oocytes (Fig. 58).

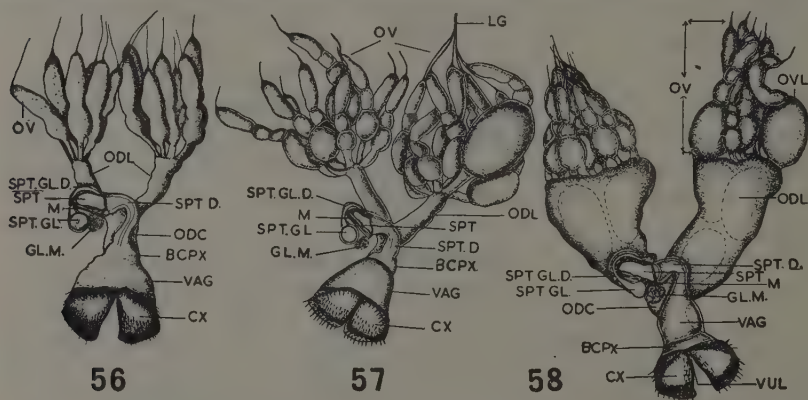


Fig. 56 : Genital organs of a newly emerged female (BCPX, bursa copulatrix; CX, coxite; GL.M., glandular mass; M, muscle band of spermatheca; ODC, median common oviduct; ODL, lateral oviduct; OV, ovary; SPT, spermatheca; SPT.D., spermathecal duct; SPT.GL., spermathecal gland; SPT.GL.D., spermathecalgland duct; VAG, vagina),  $\times 33$ . — Fig. 57 : Genital organs of a young female (LG, suspensory ligament; other lettering as in Figure 56),  $\times 33$ . — Fig. 58 : Genital organs of a mature female (VUL, vulva; other lettering as in Figure 56),  $\times 33$ .

The ovariole pedicel opens in the anterior end of the corresponding lateral oviduct (Figs. 56, 57, and 58). Each lateral oviduct (ODL) is a comparatively long tube, which is distinctly narrow in the immature female (Fig. 56), but becomes greatly distended and filled with the stored eggs, ready for deposition, in the mature individual (Fig. 58).

The two lateral oviducts unite to form the common median oviduct (Figs. 56 and 58, ODC). This is a short and wide tube, opening posteriorly by the gonopore into the anterior end of the vagina (VAG), ventral to the bursa copulatrix (BCPX).

The vagina (VAG) or genital chamber is a more or less bell-shaped chamber, which is large and distinct in the immature female (Figs. 56 and 57), while it is smaller in the mature one (Fig. 58). It receives, at its anterior end, both the apertures of the bursa copulatrix (BCPX) dorsally and the gonopore ventrally. It opens to the exterior by the vulva (VUL), between the two coxites (CX).



The spermatheca or the receptaculum seminis (Figs. 56, 57, 58, and 60, SPT) is a small sac, situated vertically in the loop formed by the ileum. The walls of the spermatheca (SPT) are irregularly thickened and well chitinized. From each end of the spermatheca (SPT) arises a pair of small chitinized processes, between which extends a transverse band of muscle fibres (M). The spermathecal duct (SPT.D.) is a curved tube which is narrower than the oviduct (ODL), and lies dorsal to the median oviduct (ODC), towards the right side. This duct opens into a conical chamber, the bursa copulatrix (BCPX), which in turn opens in the antero-dorsal end of the vagina (VAG).

Below the spermatheca (SPT), and close to the muscle band (M), there is the spermathecal gland (SPT.GL.), which is more or less spherical in outline. The secretion of this gland is carried by a narrow duct, the spermathecal gland duct (SPT.GL.D.), which is surrounded by thick muscular walls. The duct curves forwards and opens in the middle of the anterior side of the spermatheca (SPT).

Female accessory glands are totally absent, although Williams (1945) recognized in *Hippodamia convergens* Guér. and *Coccinella novemnotata* Hbst. "a pair of funnel shaped glands appearing at the posterior end of the egg exit duct, and the function of which is not known". Also the same author described a pair of colleterial glands extending from the median oviduct of *Epilachna varivestis* Muls.

In *Hyperaspis vinciguerrae* Capra, a round mass of compact tissue (GL.M.), small in the immature and large in the mature female, lies below the spermathecal gland (SPT.GL.). This mass is constantly found in all the specimens dissected. It is not similar to fat tissue in texture, as it is not vacuolated, but it is made of a compact tissue, much granular in nature and contains many nuclei.

#### b. Male reproductive organs

The male reproductive organs (Fig. 61) lie below the alimentary canal and occupy the ventral region of the abdomen. They consist of the testes, the vasa deferentia, the vesiculae seminales, the ejaculatory duct and the two pairs of accessory glands.

Each testis (Fig. 61, TES) is composed of six spherical follicles (TES.F.) enclosed within a peritoneal sheath. It lies ventrally, on one side of the alimentary canal, below the median lobe (ML). The six follicles (TES.F.) are equal in size and are arranged round the vesicula seminalis (VSM). From each testicular follicle (TES.F.) is given off a very short vas efferens (VE). The six vasa efferentia open into a short and wide common trunk (T), which in turn opens into the ventral side of the corresponding vesicula seminalis (VSM). The vas deferens (VD) is in the

form of a V-shaped loop which lies dorsal to the testis. Its proximal end is swollen to form the vesicula seminalis (VSM), which projects a little in front of the testis. The two vasa deferentia of both sides unite and form the ejaculatory duct (DEJ). This is a long and narrow tube, about one

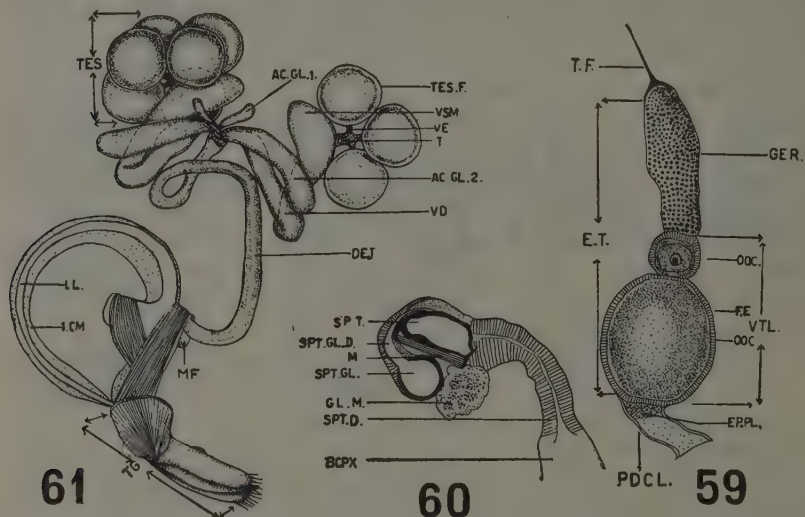


Fig. 59 : An ovariole (EP.PL., epithelial plug; E.T., egg tube; F.E., follicular epithelium; GER, germarium; OOC, oocyte; PDCL, ovariole pedicel; T.F., terminal filament; VTL, vitellarium),  $\times 75$ . — Fig. 60 : Spermatheca with its gland, duct and bursa copulatrix; lettering as in Figure 56),  $\times 75$ . — Fig. 61 : Genital organs of the male (AC.GL.1, inner accessory gland; AC.GL.2, outer accessory gland; 1.CM, first connecting membrane; DEJ., ejaculatory duct; LL., lateral lobe; MF, median foramen; T, trunk formed from the vasa efferentia; TES, testis; TES.F., testicular follicle; TG, tegmen; VD, vas deferens; VE, vas efferens; VSM, vesicula seminalis),  $\times 33$ .

and a half times as long as the vas deferens. It runs posteriorly forming a coil below the median lobe (ML), and then it overlaps the latter. It curves towards the right side, where it extends in the median lobe (ML), through the median foramen (MF), as the internal sac (Fig. 62, IS). The base or the proximal end of the ejaculatory duct (DEJ) is slightly swollen, and receives the apertures of the accessory glands.

There are two pairs of accessory glands in the male, an inner pair and an outer pair, both of which have swollen proximal ends. The inner pair (AC.GL.1) lies in the middle and is very small, while the outer pair (AC.GL.2) is much larger. Each gland of the latter pair lies close to the dorsal surface of the vas deferens of its side. The openings of the two pairs of accessory glands into the swollen proximal end of the ejaculatory duct (DEJ) are very close to each other.

## c. Musculature of the male genitalia

The musculature of the male genitalia (Fig. 62) is composed of the following paired and unpaired muscles :

(1) The median lobe-basal piece muscles. These are two sets of paired muscles, a right pair and a left pair. The right pair (ML.BP.1) originates from the right side of the expanded end (A) of the median lobe (ML),

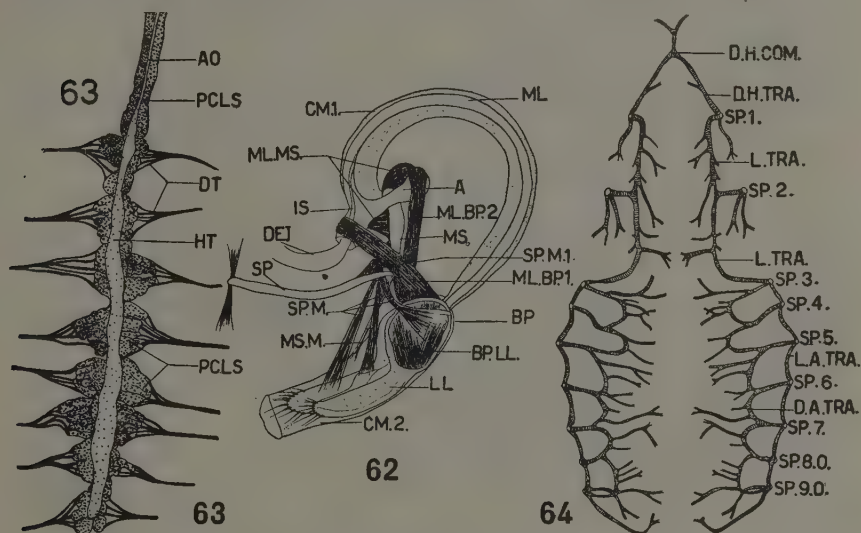


Fig. 62 : Musculature of the male genitalia (A, transverse apodeme of median lobe; BP, basal piece; BP.LL., basal piece-lateral lobe muscle; CM.1, first connecting membrane; CM.2, second connecting membrane; DEJ, ejaculatory duct; IS, internal sac; LL, lateral lobe; ML, median lobe; ML.BP.1 and 2, median lobe basal piece muscles; ML.MS., median lobe strutal muscles; MS, median strut; MS.M., strutal muscle; SP, spicule; SP.M.8 and SP.M.1, spicule muscles),  $\times 50$ . — Fig. 63 : The heart and the aorta of the adult (AO, aorta; DT, alary muscles; HT, heart; PCLS, pericardial cells),  $\times 50$ . — Fig. 64 : Dorsal tracheation of the adult (D.A.TRA., dorsal longitudinal trunk of the abdomen; D.H.COM., dorsal head commissure; D.H.TRA., dorsal head trunk; L.A.TRA., lateral abdominal trunk; L.TRA., dorsal longitudinal thoracic trunk; SP.1, mesothoracic spiracle; SP.2, metathoracic spiracle; SP.3-7, abdominal spiracles, SP.8.O. and SP.9.O., rudimentary sixth and seventh abdominal spiracles),  $\times 50$ .

near the entrance of the ejaculatory duct (DEJ) into the latter. It extends obliquely and is inserted on the anterior margin of the basal piece (BP). The other pair (ML.BP.2) originates from the left side of the expanded basal end (A) of the median lobe (ML) and is inserted on the basal piece (BP), behind the origin of the median strut (MS). In *Epilachna indica* Muls. these two sets of muscles are represented by one set only, the siphobasal muscle (Pradhan 1935).

(2) Median lobe-strutal muscles (ML.MS.) are also two pairs. The first pair (ML.MS.) originates from the middle of the expanded base (A) of the median lobe (ML) and is inserted fan-wise on the right margin of the median strut (MS), near the middle. The second pair (ML.MS.) originates from the left side of the expanded end (A) of the median lobe (ML) and is inserted on the swollen head of the median strut (MS). These muscles are represented in *Epilachna indica* Muls. by one pair only, the siphon-strutal muscle (Pradhan 1936).

(3) The basal piece-lateral lobe muscles (BP.LL). The fibres of these muscles originate from the inner surface of the anterior margin of the basal piece (BP) and are inserted on the base of each lateral lobe (LL).

(4) The spicule muscles are four unpaired sets of muscles. One of these sets (SP.M.1) originates from the right side of the spicule (SP) and is inserted on the median strut (MS) near the middle. The other three muscles (SP.M.) originate from the same point of the spicule, from the left side, and are inserted on the second connecting membrane (CM.2). In *Epilachna indica* Muls. these muscle sets are represented by three muscles only, the rod muscles (Pradhan 1935).

The spicule (SP) is attached to the sides of the ninth abdominal segment by means of a pair of transverse muscles.

(5) The strutal muscles (MS.M.) form one small set which originates from the median strut (MS) and is inserted on the dorsal surface of the second connecting membrane (CM.2).

### 5. The circulatory system

The circulatory system (Fig. 63) consists of the dorsal vessel. This extends below the tergum in the mid-dorsal line, from the hind end of the body forwards through the thorax and terminates in the head, just behind the brain. It comprises the heart and the aorta.

The heart (HT) extends along the abdominal region. It is composed of a continuous unstricted muscular tube, which is of the same width throughout its length. It is membranous, slightly convex dorsally and flattened ventrally.

The heart (HT) is attached to the terga by means of the alary muscles (DT). These are eight pairs, each of which originates from the intersegmental membrane, from the sides, between the terga, and extends towards the middle line as fan-shaped fibres which are inserted on the lateral walls of the heart (HT). The first pair of alary muscles originates from in between the first and second abdominal terga, while the eighth pair originates from the middle of the eighth abdominal tergum.



The aorta (AO) is the anterior portion of the dorsal vessel which extends along the thorax and terminates in the head region. The aorta (AO) is a narrow tube which is slightly swollen at its beginning. In the meso- and metathorax the aorta lies below the longitudinal muscles of the tergum, while in the prothorax it lies just above the alimentary canal.

In close attachment to the sides of the heart (HT) and the aorta (AO) are the pericardial cells (PCLS). These are small and multinucleated, with much granulated cytoplasm. On either side of the heart (HT) the pericardial cells (PCLS) are grouped in eight masses which correspond in number to the alary muscles (DT), while on either side of the aorta (AO) they are in the form of a longitudinal strand.

#### 6. The respiratory system

Nine pairs of spiracles are present in the adult. Of these the seven anterior pairs are functional, while the two posterior pairs are not functional.

There are two pairs of spiracles on the thorax and seven pairs on the abdomen. The first thoracic pair or mesothoracic spiracles (Fig. 64, SP.1) opens on the membrane connecting the prothorax with the mesothorax, from the sides. The second pair of thoracic spiracles (SP.2) opens on the membrane between the metatergum and the mesepimeron. These two pairs of spiracles are nearly equal in size. The first pair of abdominal spiracles (SP.3) opens to the outside on the membranous pleura of the first abdominal segment. It is nearly twice the size of any of the other abdominal spiracles. The sixth and the seventh pairs of abdominal spiracles (SP.8.O. and SP.9.O.) are closed and not functional appearing from the inside only, as mere specks on the sixth and seventh abdominal pleura respectively. Similar non-functional spiracles were also recorded from *Epilachna corrupta* Muls. (Sweetman 1930).

The tracheal system of the adult consists on either side, of longitudinal trunks, which are a dorsal (Fig. 64, L.TRA.) and a ventral (Fig. 65, V.TRA.) longitudinal trunks in the thorax, and a dorsal (Fig. 64, D.A.TRA.) and a lateral (Fig. 64, L.A.TRA.) longitudinal trunks in the abdomen. The head is supplied with tracheae arising from the first pair or mesothoracic spiracles (SP.1).

##### a. Tracheation of the head

The tracheae of the head arise from four main trunks (Figs. 64 and 65); two dorsal (Fig. 64, D.H.TRA.) and two ventral (Fig. 65, H.V.TRA.) all communicating with the mesothoracic spiracles (Fig. 64, SP.1). Each dorsal head trunk (D.H.TRA.) divides into two branches, an upper branch and a lower branch. The upper branch supplies the prothoracic tergum and



the adjoining structures. The lower branch joins its fellow, from the opposite side, in the front end of the prothorax, above the alimentary canal, to form the dorsal head commissure (D.H.COM.). From the latter arises a median trachea which divides into two branches on the dorsal surface of the brain, which it supplies.

On leaving the spiracle, the ventral head trunk (Fig. 65, H.V.TRA.) divides into two branches; one branch supplies the prosternal muscles, the fore-legs and the adjacent structures, while the other branch extends forwards and joins its fellow from the opposite side, near the anterior end of the cervical region, to form two ventral head commissures (H.V.COM.), which lie above the nerve cord. From the commissures thus formed, a large trachea is given on either side, and enters the head, where it divides to supply the ventral surface of the brain, the antenna, the labrum, the mouth parts of its side and the hypopharynx.

#### b. Tracheation of the thorax

In the thorax there are two pairs of tracheal trunks, a dorsal pair (Fig. 64, L.TRA.) and a ventral pair (Fig. 65, V.TRA.). The dorsal and the ventral tracheal trunks of one side extend from the mesothoracic spiracle (Fig. 64, SP.1) with which they communicate. On their way they also become connected with the metathoracic spiracle (SP.2) by a transverse spiracular trachea, and finally end at their connection with the first abdominal spiracle (SP.3).

The two dorsal tracheal trunks (Fig. 64, L.TRA.) run on both sides of the alimentary canal. Each supplies the dorsal muscles of the meso- and the metatergum, the elytron of its side and the mesenteron. Each of the ventral longitudinal trunks (Fig. 65, V.TRA.) runs on one side of the nerve cord, and supplies the ventral region of the alimentary canal, the sternal muscles and the legs of the meso- and the metathorax.

Other than the dorsal and ventral longitudinal trunks, there are two small tracheae, which communicate with the mesothoracic spiracle (Figs. 64 and 65) and which supply the mesopleuron. The hind wings and a part of the metathoracic muscles are supplied with separate tracheal branches, which communicate with the metathoracic spiracles (Figs. 64 and 65).

#### c. Tracheation of the abdomen

There are four longitudinal tracheal trunks in the abdomen, of which two are lateral (Fig. 64, L.A.TRA.) and two are dorsal (D.A.TRA.). Each lateral longitudinal trunk (L.A.TRA.) extends below the pleura, between the seven abdominal spiracles. Communicating with the latter spiracles, on either side, there are seven dorsal spiracular tracheae, which are connected together by the dorsal longitudinal trunk (D.A.TRA.). This trunk

supplies the abdominal tergal muscles, the heart, the alimentary canal, the fat body and the genital organs. The metatergal muscles are also supplied with tracheae arising from the first abdominal spiracular trachea. Other tracheal branches arise from the rudimentary seventh abdominal spiracles (SP. 9.O.), and supply the different organs and genitalia lying in the eighth abdominal segment.

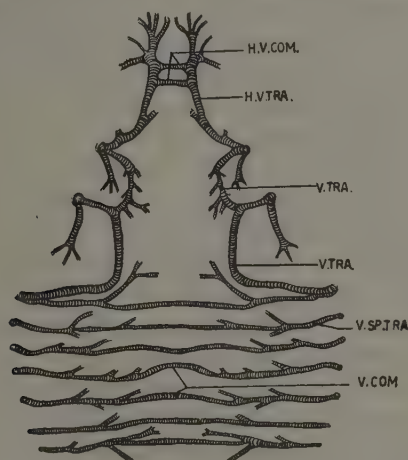


Fig. 65 : Ventral tracheation of the adult (H.V.COM., ventral head commissure; HV. TRA., ventral head trunk; V.COM., ventral commissure; V.SP.TRA., ventral spiracular trachea; V.TRA., ventral longitudinal trunk of thorax),  $\times 25$ .

The ventral tracheation of the abdomen (Fig. 65) consists of paired spiracular tracheae (V.SP.TRA.) which are segmentally arranged. These are much branched and supply the ventral surface of the alimentary canal, the genital organs and the sternal muscles of its segment. The ventral spiracular tracheae (V.SP.TRA.) of each of the seven pairs are connected with each other by a ventral transverse commissure (V.COM.).

## V. REFERENCES

- Bruneteau, J. (1927) : Contribution à l'étude des caractères extérieurs et pièces squelettiques du doryphore "*Leptinotarsa decemlineata* Say" (Rev. Zool. Agric. App., Bordeaux, 26, pp. 121-128, 137-140 et 153-159).
- Crampton, G.C. (1926) : A comparison of the neck and prothoracic sclerites throughout the orders of insects from the standpoint of phylogeny (Trans. Amer. Ent. Soc., Philadelphia, 52, pp. 199-248).

- Crampton, G.C. (1929) : The terminal abdominal structures of female insects throughout the orders from the standpoint of phylogeny (*J.N.-Y. Ent. Soc.*, 37, pp. 453-496).
- Crowson, R.A. (1938) : The metendosternite in Coleoptera : a comparative study (*Trans. R. Ent. Soc. London*, 87, pp. 397-416).
- Crowson, R.A. (1944) : Further studies on the metendosternite in Coleoptera (*Trans. R. Ent. Soc. London*, 44, (1945), pp. 273-310).
- El-Sayed, T. (1940) : The morphology, anatomy and biology of *Araecerus fasciculatus* De Geer [Coleoptera : Anthribidae] (*Bull. Soc. Fouad I Entom.*, 24, pp. 82-152).
- Ferris, C.F. (1935) : The prothoracic pleurites of Coleoptera (*Ent. News*, 46, No. 3, pp. 63-68, 93-95).
- Forbes, W.T.M. (1922) : The wing venation of Coleoptera (*Ann. Ent. Soc. Amer.*, 15, pp. 328-352).
- Forbes, W.T.M. (1926) : The wing folding patterns of the Coleoptera (*J.N.-Y. Ent. Soc.*, 34, pp. 42-68, 91-138).
- Graham, S.A. (1922) : A study of the wing venation of Coleoptera (*Ann. Ent. Soc. Amer.*, 15, pp. 191-200).
- Ibrahim, M.M. (1948) : The morphology and anatomy of *Coccinella undecimpunctata aegyptiaca* Reiche [Coccinellidae : Coleoptera] (*Bull. Soc. Fouad I Entom.*, 32, pp. 305-316).
- Jeannel, R. (1925) : Morphologie de l'élytre des Coléoptères Adephages (*Arch. Zool. Exp. Gén.*, Paris, 64, pp. 1-84).
- Liu, Chi-Ying (1932) : Notes on the biology of the two giant Coccinellids in Kwangsi (*Caria dilatata* Fabr. and *Synonycha grandis* Thunbg.), with special reference to the morphology of *Caria dilatata* (Year-Book Bur. Ent., Hangchow, Chekiang (1933), pp. 205-250).
- Pradhan, S. (1935) : The genitalia and their role in copulation in *Epilachna indica* [Coccinellidae : Coleoptera], with a discussion on the morphology of the genitalia in the family (*Proc. Acad. Sc. U.P.*, India, 5, part 2, pp. 250-263).
- Pradhan, S. (1937) : Labial glands in Coleoptera (*Curr. Sc.*, Bangalore, 5, No. 11, pp. 590-591).
- Pradhan, S. (1938) : Neuromuscular study of the mouth parts of *Coccinella septempunctata*, with a comparison of the mouth-parts in carnivorous and herbivorous Coccinellids (*Rec. Ind. Mus.*, Calcutta, 40, part 14, pp. 341-358).
- Pradhan, S. (1939) : Glands in the head-capsule of Coccinellid beetles, with a discussion on some aspects of gnathal glands (*J. Morph.*, 64, No. 1, pp. 47-66).

- Rivnay, E. (1928) : The external morphology of the Colorado potato beetle "*Leptinotarsa decemlineata*" (*J. N.-Y. Ent. Soc.*, 36, pp. 125-142).
- Sharp, S. and Muir, F. (1912) : Comparative anatomy of the male genital tube in Coleoptera (*Trans. Ent. Soc. London*, 6, pp. 220-322).
- Snodgrass, R.E. (1908) : A comparative study of the thorax in Orthoptera, Euplexoptera, and Coleoptera (*Proc. Ent. Soc. Washington* (1907), pp. 95-108).
- Snodgrass, R.E. (1935) : Principles of insect morphology (McGraw-Hill Book Co., New York and London).
- Stickney, F.S. (1923) : The head capsule of Coleoptera (*Illinois Biol. Mongr.*, 8, pp. 1-104).
- Sweetman, H.L. (1930) : The external morphology of the Mexican bean beetle "*Epilachna corrupta* Muls." [Coccinellidae: Coleoptera] (*J. N.-Y. Ent. Soc.*, 38, pp. 423-452).
- Tanner, V.M. (1927) : A preliminary study of the genitalia of female Coleoptera (*Trans. Amer. Ent. Soc.*, Philadelphia, 53, No. 1, pp. 5-50).
- Tower, W.L. (1903) : The origin and development of wings in Coleoptera (*Zool. Jahrb. Anat.*, 17, pp. 517-572).
- Wigglesworth, V.B. (1947) : The principles of insect physiology (Methuen and Co. Ltd., London).
- Williams, J.L. (1945) : The anatomy of the internal genitalia of some Coleoptera (*Proc. Ent. Soc. Washington*, 47, No. 4, pp. 73-87).
- Wilson, J.W. (1926) : The genitalia of some of the Coccinellidae (*J. Elisha Mitchell Sci. Soc.*, Chapel Hill, 42, pp. 63-74).
- Wilson, J.W. (1929) : The male genital tube of some of the species of the genus *Scymnus* [Coccinellidae: Coleoptera] (*Psyche*, Boston, Mass., 34, pp. 167-170).
- Wilson, J.W. (1930) : The genitalia and wing venation of the Cucujidae and related families (*Ann. Ent. Soc. Amer.*, 23, pp. 305-358).





# On the histology of the alimentary canal of *Hyperaspis vinciguerrae* Capra

[ Coleoptera : Coccinellidae ]

(with 22 Text-Figures)

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## I. INTRODUCTION

The histology of the alimentary canal of Coccinellid beetles has been studied in a number of species, e.g. *Epilachna corrupta* Muls. (Potts 1927 and Burgess 1932), *Geratomegilla fusculabris* Muls. (Landis 1936), and *Epilachna indica* Muls. and *Coccinella septempunctata* L. (Pradhan 1936, 1939 and 1942).

In the present work, the histology of the alimentary canal of *Hyperaspis vinciguerrae* Capra was studied and compared with that of other species.

For making histological preparations of the alimentary canal the material was best fixed in hot Bouin's solution and then embedded. Simple and double embedding methods were used for the preparation of serial sections. These were stained in haemalum which was used as a nuclear stain, and chromotrop 2R which proved very satisfactory as a protoplasmic stain.

All drawings were made with the aid of the camera lucida.

The present work was carried out in the Department of Entomology, Faculty of Science, Fouad I University, Cairo. The authors are indebted

to Professor H.C. Efflatoun Bey for his kind help and constant encouragement.

## II. HISTOLOGY OF THE ALIMENTARY CANAL

The walls of the alimentary canal have the same essential histological structure as that of the body integument. They consist of a layer of cells, the enteric epithelium, resting upon a basement membrane and lined internally by a layer of cuticular intima, in the stomodaeal and proctodaeal regions. The alimentary canal is lined by a layer of muscular sheath called the muscularis.

### 1. The fore-gut or stomodaeum

#### a. Pharynx

The pharynx of *Hyperaspis vinciguerrae* Capra (Fig. 1) differs from that of other Coccinellid beetles in the relative development of its constituents.

The intima (INT), or the innermost layer is thick, broad and roughly thrown into six longitudinal folds of unequal heights. Its inner surface is jagged, distinctly irregular and wavy in appearance. From this layer arise the dilator muscles of the pharynx.

Outside the intima (INT), there is a thin epithelial layer (EP) in which the six longitudinal folds are not distinct. The nuclei are moderate in size and oval in shape. They are distinct and with clear deeply staining chromatin granules. The cytoplasm is homogenous and non-granular. Cell divisions are not distinct, even under very high power of magnification.

The basement membrane (B.M.) is not distinct throughout the entire contour of the pharynx, being only visible in some parts.

The muscularis is prominent and strongly developed. It is composed of an inner longitudinal muscle layer (L.M.) and an outer circular muscle layer (C.M.). The longitudinal muscles (L.M.) are in the form of broad and stout strands, disposed in two groups, one in the dorsal and the other in the ventral regions of the pharynx, just outside the epithelium (EP). These strands are connected together by loose connective tissue (C.T.), which fills the spaces between the epithelium and the muscularis. The dorsal longitudinal muscle group, has more numerous strands than the ventral group. The circular muscle layer (C.M.) is usually represented by more than one layer of well developed muscle fibres.

Externally, the pharynx is invested by a very thin layer of connective tissue.

The histology of the pharynx was described in certain beetles namely, *Epilachna corrupta* Muls. (Potts 1927 and Burgess 1932), *Ceratomygilla fuscilabris* Muls. (Landis 1936), *Epilachna indica* Muls. (Prad-

han 1936) and *Coccinella septempunctata* L. (Pradhan 1939). In all these cases the structure is basically the same as that of *Hyperaspis*, the only fundamental difference being the absence of the longitudinal muscle layer in both *Epilachna indica* Muls. (Pradhan 1936) and *Coccinella septempunctata* L. (Pradhan 1939).

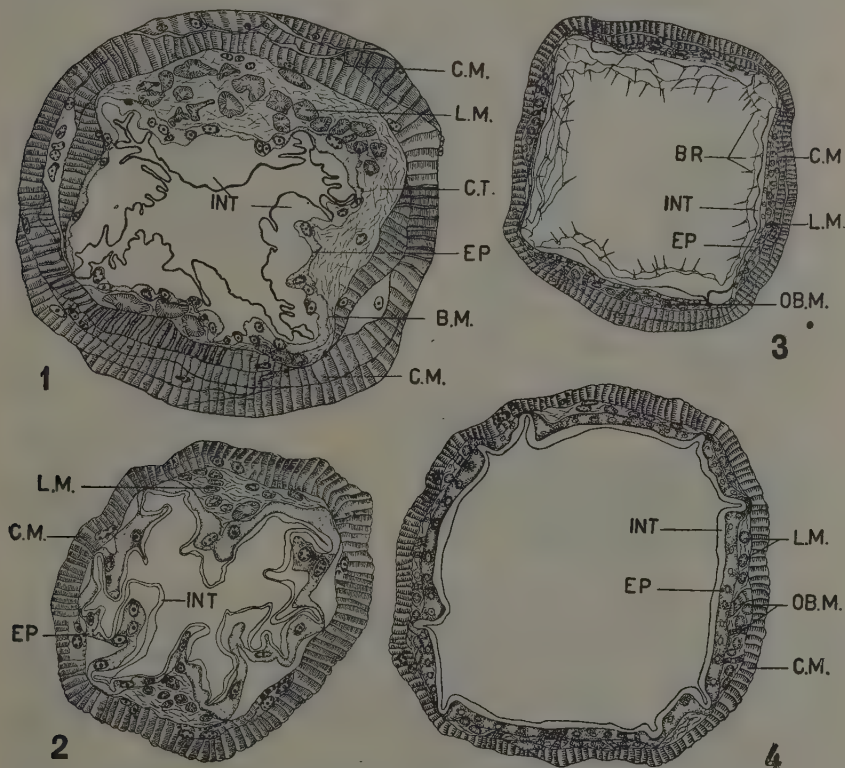


Fig. 1 : Transverse section through the pharynx (B.M., basement membrane; C.M., circular muscles; C.T., connective tissue; EP, epithelium; INT, intima; L.M., longitudinal muscles),  $\times 500$ . — Fig. 2 : Transverse section through the oesophagus (lettering as in Figure 1),  $\times 500$ . — Fig. 3 : Transverse section through the anterior region of the crop (BR, bristles; OB.M., oblique muscles; other lettering as in Figure 1),  $\times 293$ . — Fig. 4 : Transverse section through the posterior region of the crop (lettering as in Figures 1 and 3),  $\times 293$ .

#### b. Oesophagus

The oesophagus (Fig. 2) is about half the pharynx in diameter. Its wall is essentially composed of the same layers as those of the pharynx (Fig. 1). The intima (Fig. 2, INT.) is here much thinner than in the pharynx, and is separated at some parts from the epithelium (EP). The

six longitudinal folds are also more pronounced. This observation is in agreement with that of Potts (1927) on *Epilachna corrupta* Muls., and not with that of Pradhan (1936) on *Epilachna indica* Muls. The latter author claims that the longitudinal folding is not oesophageal but pharyngeal.

The epithelium (EP) which follows closely the folding of the intima (INT) is of the same nature as that of the pharynx (Fig. 1, EP), except that it is much broader with relatively larger nuclei.

The muscularis is less developed, but has the same structure and arrangement as that of the pharynx. In *Epilachna indica* Muls. (Pradhan 1936) and *Coccinella septempunctata* L. (Pradhan 1939) this layer is scattered round the oesophagus.

No teeth or spines were ever found on the intima of the oesophagus of *Hyperaspis vinciguerrae* Capra. Potts (1927) described teeth on the intima of the oesophagus of *Epilachna corrupta* Muls., while Burgess (1936) referred to the presence of thick short spines as well as scales on the oesophagus of *Ceratomegilla fuscilabris* Muls. In *Epilachna indica* Muls. (Pradhan 1936) and *Coccinella septempunctata* L. (Pradhan 1939), no teeth were found on the oesophageal intima.

### c. Crop

The crop of *Hyperaspis vinciguerrae* Capra (Figs. 3, 4, and 5) presents an interesting feature with regards to the nature of the intima and the arrangement of the bristles.

The crop (Fig. 5) is pear-shaped with a narrow anterior region and a wide posterior region. In the posterior region of the crop (Fig. 4) the epithelium (EP) and its lining intima (INT) are thrown into four major longitudinal folds which have flat inner surfaces, alternating with four minor longitudinal ones. The intima (INT) is heavily chitinized and is one layer thick. It carries neither teeth nor spines.

The intima of the narrow anterior region of the crop (Fig. 3, INT) is irregularly folded. The folds are more or less projecting and almost blocking the cavity of the crop especially in its anteriormost region. The intima (INT) is here much broader and less heavily chitinized. It is found in more than one layer, each layer carries a row of long backwardly directed bristles (Figs. 3 and 5, BR).

From its structure, the anterior region of the crop seems to act as a sieve for the food entering its cavity.

The nature of the epithelium in the two regions (Figs. 3 and 4, EP) is identical, except it is narrower in the anterior than in the posterior region. The nuclei are small and are closely set one beside the other. The



cytoplasm is finely granulated and there are no distinct cell walls separating the nuclei.

In *Epilachna indica* Muls. (Pradhan 1936) and *Coccinella septempunctata* L. (Pradhan 1939) it was pointed out that the intima of the crop throughout its entire length is divided into four well defined major

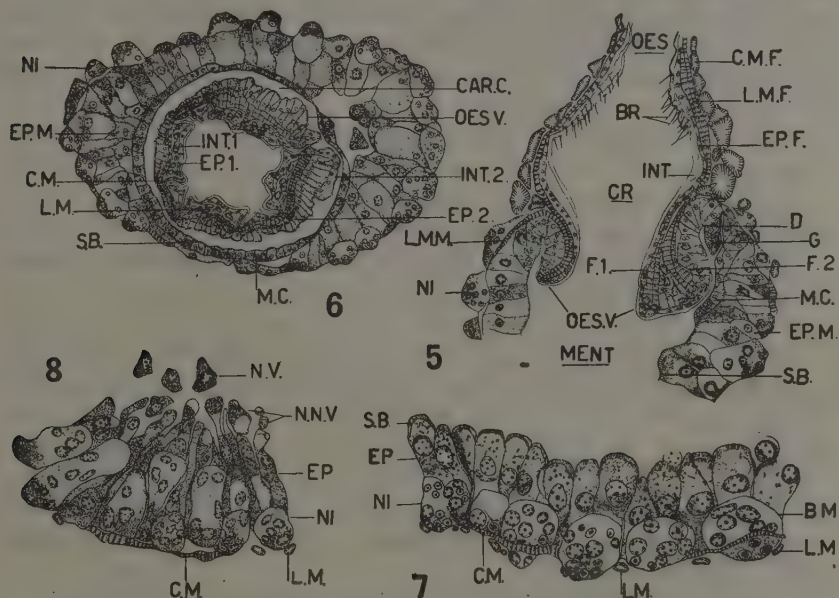


Fig. 5 : Longitudinal section through the oesophageal valve (BR, bristles; C.M.F., circular muscle layer of fore-gut; CR, crop; D, point of junction between fore- and mid-gut; EP.F., fore-gut epithelium; EP.M., mid-gut epithelium; F.1, inner fold of oesophageal valve; F.2, outer fold of oesophageal valve; G, cells secreting the peritrophic membrane; INT, intima; L.M.F., longitudinal muscle layer of fore-gut; L.M.M., longitudinal muscle layer of mid-gut; M.C., cells lining the cardiac cavity; MENT, mesenteron; NI, nidi; OES, oesophagus; OES.V., oesophageal valve; S.B., striated border),  $\times 175$ . — Fig. 6 : Transverse section through the oesophageal valve (CAR.C., cardiac cavity; EP.1, epithelium of the inner fold of the oesophageal valve; EP.2, epithelium of the outer fold; EP.M., epithelium of mesenteron; INT.1 and INT.2, intima of inner and outer folds; S.B., striated border; other lettering as in Figures 1 and 5),  $\times 175$ . — Fig. 7 : Portion of a transverse section through the anterior region of mesenteron, to show the newly formed epithelium (BM, basement membrane; EP, epithelium; C.M., circular muscles; L.M., longitudinal muscles; NI, nidi; S.B., striated border),  $\times 293$ . — Fig. 8 : Portion of a transverse section through the anterior region of the mesenteron during active secretion (N.N.V., non-nucleated vesicle; N.V., nucleated vesicle; other lettering as in Figure 7),  $\times 293$ .

longitudinal folds, alternating with four minor ones. From each of the major folds arise a number of long narrow bristles.

It is therefore clear, that while in *Epilachna indica* Muls. and *Coccinella septempunctata* L. the bristles occur on the entire length of the crop,



they are only confined in *Hyperaspis vinciguerrae* Capra to the anterior region. Also the whole intimal covering in these two Coccinellids is regularly folded and of the same thickness throughout (Pradhan 1936 and 1939), contrary to what is found in *Hyperaspis*.

In *Epilachna corrupta* Muls., Burgess (1932) found that the entire length of the crop is spined, while Landis (1936) described from the crop of *Ceralomegilla fuscilabris* Muls. twelve or more rows of spines, each containing from fifteen to twenty five posteriorly directed spines, which project into the lumen.

The muscularis of the crop of *Hyperaspis* has the same structure throughout its length. It is composed of :

(1) Longitudinal muscles (Figs. 3 and 4, L.M.) which are found as separate thin fibres outside the epithelium (EP) round the crop. The fibres are very thin and more numerous than those of the oesophagus and pharynx. The longitudinal muscles of the crop are inserted on the intima within the oesophageal valve (Fig. 5, OES.V.).

(2) Oblique muscles (Figs. 3 and 4, OB.M.) which are structurally the same as those found in the wall of the crop of *Epilachna indica* Muls. (Pradhan 1936). They are inserted at different levels on the epithelium (EP) as well as on the intima (INT) of the major folds of the crop, between the longitudinal muscles (L.M.).

From their mode of attachment, Pradhan (1936 and 1939) attributed to them the function of acting as dilators of the major folds and erectors of the bristles of the crop.

(3) Circular muscles (C.M.) which form the outermost muscular layer. It is rather thin and encircles the crop completely .

Intrinsic muscles, which stretch between the two adjacent walls of a fold, and which were described from the wall of the crop of *Epilachna indica* Muls. (Pradhan 1936) and *Coccinella septempunctata* L. (Pradhan 1939) do not occur in *Hyperaspis vinciguerrae* Capra.

#### d. Oesophageal valve

The cardiac or oesophageal valve (Figs. 5 and 6, OES.V.) is a funnel-shaped structure, which projects from the stomodaeum into the cavity of the anteriormost end of the mid-gut. Structurally it has an inner (Fig. 5, F.1) and an outer (F.2) folds or lamellae, which are produced by the invagination of the fore-gut epithelium (EP.F.). Both lamellae (F.1 and F.2) are covered with a layer of chitinous intima (Fig. 6, INT.1 and INT.2), characteristic of the fore-gut, and are separated by a space which is filled with the muscularis.

The intima (INT.1) and epithelium (EP.1) of the inner lamella (Fig. 5, F.1) are both thrown into the four major longitudinal folds, alternating

with the four minor ones which characterise the crop. The epithelium (Fig. 6, Ep.1) is similar in structure to that of the crop. It is thin with finely granulated cytoplasm and with closely set nuclei. Cell divisions are not distinct.

The intima (Fig. 6, INT.2) of the outer lamella (Fig. 5, F.2) is thin and is not folded like that of the inner lamella. The epithelium of the outer lamella (Fig. 6, EP.2) is similar in shape and structure to that of the mid-gut. It is composed of elongate narrow columnar cells, distinctly separated from each other by cell walls. The nuclei of the columnar cells are small, and are disposed towards the bases of the cells in an even row, following the contour of the epithelium.

The muscularis is here a direct continuation of that of the crop, filling the space between the inner and the outer lamellae (Fig. 5). It consists of well developed longitudinal muscle strands (Fig. 6, L.M.), which are either directly inserted on the intima or on the epithelial lining of the folds. The outer longitudinal muscles of the mesenteron also extend within the oesophageal valve (Fig. 5, L.M.M.). The circular muscles (Fig. 6, C.M.) form an annular band round the oesophageal valve between the folds. It is comparatively thin and in one layer only.

From the wall of the mesenteron (Fig. 5, MENT), facing the outer fold of the oesophageal valve (F.2), is cut off a layer of small cubical cells. This layer lines the cardiac cavity (Fig. 6, CAR.C.) round the valve. The cells (Figs. 5 and 6, M.C.) have distinct striated border and comparatively small nuclei.

From the histological nature of the oesophageal valve, it is clear that the wall is too rigid to act as a real valve, and so its function is most likely to conduct the food well from the ventriculus to the stomach lumen. Similar conclusion was given about the oesophageal valve of *Epilachna indica* Muls. (Pradhan 1936).

## 2. The mid-gut or mesenteron

From the morphological point of view, the mid-gut begins at the base of the outer fold of the oesophageal valve (Fig. 5, D), and ends just at the bases of the malpighian tubes (Fig. 12, M.T.).

The stomach of *Hyperaspis vinciguerrae* Capra shows no regional differentiation, being more or less of uniform structure throughout. From the anterior end of the stomach, round the base of the outer fold (Fig. 5, F.2) of the stomodaeal invagination (OES.V.), is cut off an annular triangular sheet of cells (G), the apex of which is towards the lumen of the stomach. This sheet of cells is supposed to secrete the peritrophic membrane (Wiglesworth 1930).

The wall of the ventriculus is thicker than that in any other part of the alimentary canal. Usually it consists from within outwards, of the mesenteric epithelium, the basement membrane, the regenerative cells or nidi, and the muscularis.

In the newly formed epithelium of the stomach (Fig. 7, EP.), the cells are generally columnar in shape and with distinct cell walls. Their striated and deeply staining inner borders (S.B.) are irregular, and are more or less projecting into the lumen of the stomach.

The digestive cells of the stomach usually present variable forms, according to their physiological condition. Thus in some parts, the cells may be triangular or cubical in form, or may have very narrow attenuated bases and spherical clubbed apices, which project into the stomach cavity, and contain the nuclei. All these cell shapes may be present in one and the same part of the stomach.

The epithelial cells contain large, well defined and almost round nuclei, which are disposed near the bases of the cells. These nuclei are heavily loaded with chromatin granules, of which one or two are large in size, and form the nucleoli. The cytoplasm differs very much in the individual cells according to their physiological activity. It may be coarsely granulated and deeply staining (Fig. 7), or it may be spongy in nature, much vacuolated and less coarsely granular (Fig. 9), or the cytoplasm may be finely granulated and non-vacuolar (Fig. 10).

The striated border (S.B.) is fairly broad, deeply staining and of uniform structure throughout the ventriculus.

On examining the several serial sections, it was found that four types of cells enter into the formation of the epithelial lining of the stomach. The first type consists of cells which are short and cubical. The cells of the second type are columnar in shape. These two types of cells are arranged over or in between the nidi. The third type consists of long and columnar cells arranged in groups confined to the tops of the nidi. The fourth type contains cells which are arranged in two layers, disposed above the nidi. The one just over the nidi is formed by large cells which have hooked apices and are arranged around a large cavity. The cells of the other layer are more or less elongate and columnar in shape.

These four types of cells have been described from the wall of the mesenteron of *Coccinella septempunctata* L. by Pradhan (1939). According to this author these types of epithelial lining are derived from each other in the process of regeneration of the stomach epithelium.

The epithelium of the stomach (Fig. 7, EP) rests on a distinct and well defined basement membrane (B.M.). To the outside of this membrane are found the regenerative cells or nidi (Figs. 7, 8, 9, and 10, NI). These

are in the form of dome-like groups of nuclei (Figs. 9 and 10, NI.N.), which are provided with dense deeply staining and coarsely granulated cytoplasm. The nidi project from the external surface of the ventriculus.

The nidal nuclei (NI.N.) may be round or oval, large or small, while their number also varies from one to several in a single nidus. Usually the small nuclei are condensed towards the outer surface of the nidus while the larger ones are found scattered within the nidus, just below the epithelium (Figs. 7 and 8). The nidi themselves also vary in size; some of them may be extremely small, others may be large or very large. They are abundant and close to each other.

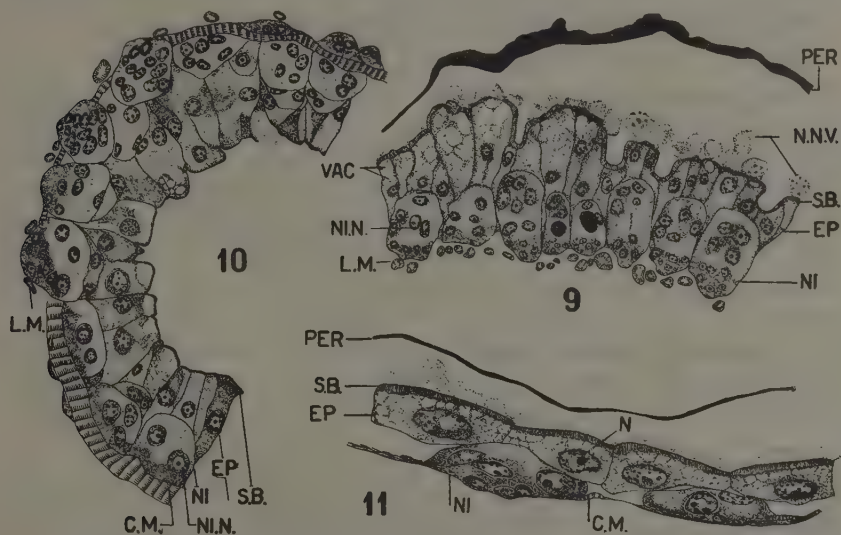


Fig. 9 : Portion of a longitudinal section through the middle region of the ventriculus during active secretion (NI.N., nidal nuclei; PER, peritrophic membrane; S.B., striated border; Vac, vacuoles; other lettering as in Fig. 8),  $\times 293$ . — Fig. 10 : Portion of a transverse section through the posterior region of the mesenteron (lettering as in Figure 8),  $\times 293$ . — Fig. 11 : Portion of a transverse section through the mesenteron, wall stretched owing to the presence of food (N, nucleus of epithelial cell; other lettering as in Figures 8 and 9),  $\times 500$ .

In the majority of the serial sections examined, the nidi lie inside the circular muscle layer (C.M.) of the ventriculus, but it was observed in some sections that some of the nidi lie outside the circular muscle layer (Fig. 7). A similar condition was previously reported from *Epilachna corrupta* Muls. by Potts (1927). This author pointed out that usually these nidi are found inside the circular muscles, however some sections indicate that under certain conditions some of the nests lie outside the muscle layer.

The muscularis of the stomach is very weakly developed and consists of an inner circular muscle layer (C.M.) and an outer longitudinal muscle



layer (L.M.). The circular muscle layer (C.M.) is not continuous round the mesenteron, but is broken in several parts. The longitudinal layer (L.M.) is composed of extremely thin and scattered muscular strands, which take their origin from the intima between the two lamellae of the oesophageal valve (Fig. 5, OES.V.).

When a part of the stomach is greatly distended owing to the presence of food, the wall becomes very thin and presents a totally different appearance (Fig. 11). The epithelial cells (EP) greatly flatten and their striated borders broaden. The nidi (NI) have become more widely separated from each other, with a less number of nuclei. The circular muscle layer (C.M.) becomes extremely thin, due to the distention of the wall.

#### a. Peritrophic membrane

The peritrophic membrane (Figs. 9 and 11, PER) was not always found in all the serial sections of all the specimens examined. It forms, when present, a continuous tube within the cavity of the mesenteron, enclosing the food. This tube is separated from the epithelial cells (EP) of the mesenteron by a space. The peritrophic membrane (PER) is not of the same thickness throughout its length. It may be thick in one place, and extremely thin in the other. This membrane is also clearly visible in the hind-gut.

A peritrophic membrane was described in some sections of the mid-gut of *Epilachna indica* Muls. as non-continuous shreds which reveal a fenestrated structure (Pradhan 1936).

#### b. Secretion of the digestive fluid

From the histological study of the serial sections of the stomach of *Hyperaspis vinciguerrae* Capra, it was observed that the discharge of the secretory products is accomplished in the following way :

The secretory materials, which are usually accumulated at the tips of the cells are discharged as little spheres of cytoplasm, extruded from in between the rods of the striated border (Fig. 9, N.N.V.). Other epithelial cells burst liberating their secretory products (Fig. 7). The vacuolated tips of some cells nip off and break down in the stomach lumen (Fig. 8, N.N.V.). This type of secretion was described by many authors as "the merocrine type of secretion". It takes place throughout the entire length of the stomach wall. It seems to be the only type by which the cells of the posterior region of the ventriculus discharge their secretory materials.

In about the anterior three quarters of the mesenteron, another type of secretion takes place. This type is "the holocrine type", in which the nucleated masses of the cytoplasm (Fig. 8, N.V.) are pinched off from the cells, and are ejected into the stomach lumen. In vigorous secretory phase.



more frequently met with in the anterior region of the stomach, the whole lining of the stomach epithelium is seen to be sloughed off and fall into the lumen.

It appears therefore, that both types of secretion, merocrine and holocrine, do occur in *Hyperaspis vinciguerrae* Capra.

The process of stomach secretion was described in some Coccinellid beetles namely, *Epilachna corrupta* Muls. (Burgess 1932), *Ceratomegilla fuscilabris* Muls. (Landis 1936), and *Epilachna indica* Muls. (Pradhan 1936). In the first two insects, the secretion is of the holocrine type. In the third, both types of secretion, that is, holocrine and merocrine, take place.

It was also observed in *Hyperaspis vinciguerrae* Capra that after every meal, the whole epithelial lining is shed, and is immediately replaced by a new one from the underlying nidi. A similar condition was reported from *Coccinella septempunctata* L. by Pradhan (1939), who pointed out that, "the digestive cells are monophasic, i.e. the secretory activity is generally more violent, and the whole cell, or in fact the whole epithelium is generally completely used up during one period of secretion and new epithelium has to be formed for the next time".

### 3. The hind-gut or proctodaeum

The hind-gut (Fig. 12, H.G.) begins just below the bases of the Malpighian tubes (M.T.). From the morphological point of view, the hind-gut is divided into an anterior intestine and a posterior intestine. The former is separated from the mid-gut (M.G.) by the pyloric valve (PY.V.), and comprises the ileum and colon, while the latter forms the rectum.

#### a. Pyloric valve

The pyloric valve (Fig. 12, PY.V.) of *Hyperaspis vinciguerrae* Capra is of the ventricular type. It is not the true proctodaeal valve which prevails among the Coleoptera.

The valve (PY.V.) consists of a small internal circular fold, formed by the cells of the mesenteric epithelium (EP.M.). It projects into the cavity at the entrance of the hind-gut (H.G.), just above the invagination of the Malpighian tubes (M.T.). The epithelium in the region of the pyloric valve (PY.V.) is many-layered. Each layer, is formed by small polygonal cells with distinct large nuclei. The innermost layer is provided with a striated border (S.B.) characteristic of the mid-gut epithelium (EP.M.). The entrance to the hind-gut is thus narrowed by the presence of this ventricular fold. The muscularis in the region of the pyloric valve, is very weakly developed (Fig. 12).

Just below the pyloric valve (PY.V.) and below the bases of the Malpighian tubes (M.T.), the wall becomes very muscular, and forms the pyloric sphincter (Fig. 13). In this region, the epithelium (EP) is covered by a very thin chitinous intima (INT) characteristic of the hind-gut. It is thrown into six main longitudinal folds, which may have small additional folds in between. The epithelium (EP) is formed by small columnar cells, closely set one beside the other, and distinctly separated by cell walls. The nuclei are oval and comparatively small, and the cytoplasm is finely granulated.

The epithelium rests upon a well defined basement membrane, which is also well developed throughout the entire length of the hind-gut.

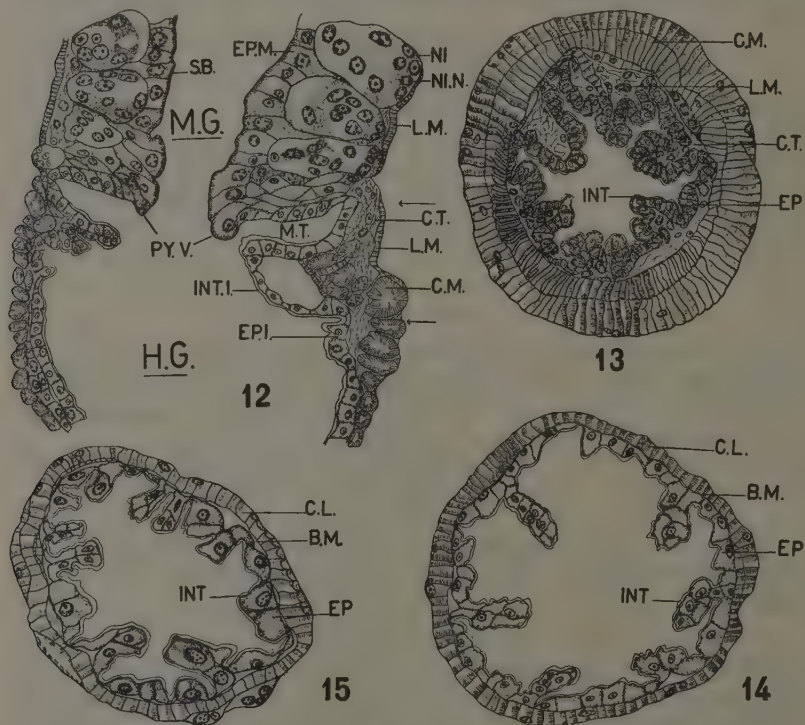


Fig. 12 : Longitudinal section through the pyloric valve (C.M., circular muscles of the pyloric sphincter; C.T., connective tissue; EP.I., epithelium of hind-gut; EP.M., mid-gut epithelium; H.G., hind-gut; INT.I., intima of hind-gut; L.M., longitudinal muscles; M.G., mid-gut; M.T., base of the Malpighian tube; PY.V., pyloric valve; other lettering as in Figure 7),  $\times 293$ . — Fig. 13 : Transverse section through the pyloric sphincter (EP, epithelium; INT, intima; other lettering as in Figure 12),  $\times 293$ . — Fig. 14 : Transverse section through the anterior region of the ileum (B.M., basement membrane; C.L., circular muscle layer; other lettering as in Figure 13),  $\times 293$ . — Fig. 15 : Transverse section through the middle region of the ileum (lettering as in Figures 13 and 14),  $\times 293$ .

The muscularis is characteristically well developed, and it is the most prominent muscle layer throughout the whole alimentary canal. It is composed of an inner longitudinal layer (L.M.) and an outer circular muscle layer (C.M.). The former consists of a number of strands, which are scattered round the pyloric sphincter, and are connected together by connective tissue (C.T.). The latter muscle layer (C.M.) is well developed, and lies to the outside. It consists of thick and broad fibres always disposed in more than one layer.

In *Epilachna corrupta* Muls. there is no typical pyloric valve (Potts 1927). Burgess (1932) in the same species, described a very well developed pyloric valve, while Landis (1936) recorded that "the pyloric valve in *Ceratomegilla fuscilabris* Muls. is not so distinct and occurs at the junction of the ileum and the mid-intestine, slightly below the origin of the Malpighian tubules".

From these descriptions, it seems that the above authors had mistaken the pyloric sphincter for the pyloric valve. This conclusion is the same as that arrived at by Pradhan (1936).

#### b. Ileum

The ileum (Figs. 14, 15, and 16) is of uniform structure throughout. The six longitudinal folds of the epithelium are evident, although additional folds may be present between the original ones, especially towards the posterior region of the ileum (Fig. 16). These folds are somewhat pointed and are widely separated from each other (Fig. 14).

The intima (INT) is fairly thin and closely follows the folding of the epithelium (EP). The epithelial cells themselves are somewhat cubical and distinctly separated from each other by cell walls. Their cytoplasm is finely granulated, and their nuclei are well defined, moderate in size and contain little chromatin granules. The basement membrane (B.M.) is clear and distinct.

The muscularis is composed of a thin layer of circular muscles (C.L.), which are continuous round the ileum. Longitudinal muscles in the ileum region are completely absent.

The transition between the ileum and colon is gradual. At the junction of the two parts (Fig. 16), the six Malpighian tubes (M.T.) become closely attached to the wall of the colon, and are enclosed by a thin peritoneal sheath known as the fascia (FAS). The space or chamber formed between the colon and the fascia (FAS), and in which the Malpighian tubes (M.T.) lie, is known as the fascial chamber (CH).

#### c. Colon

Compared with the ileum, the colon (Fig. 17) shows a number of morphological differences. For instance, the wall is much thicker. The folds

of the epithelium are shorter, broader and not projecting into the cavity. The intima (INT) is more heavily chitinized, while the epithelial cells (EP) are larger and broader than long. Each epithelial cell of the colon is provided with a relatively large nucleus, charged with deeply staining large chromatin granules. The cytoplasm of the cells is coarsely granulated and the basement membrane (B.M.) is distinct.

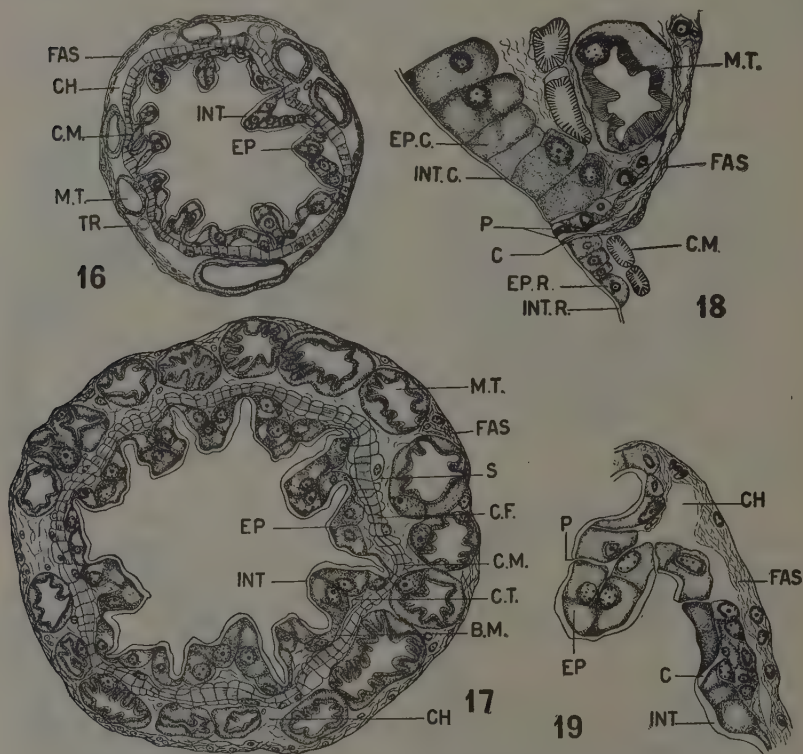


Fig. 16 : Transverse section through the posterior region of the ileum, showing the beginning of re-association of the Malpighian tubes (CH, fascial chamber; C.M., circular muscle layer; EP, epithelium; FAS, fascia; INT, intima; M.T., Malpighian tube; TR, trachea),  $\times 293$ . — Fig. 17 : Transverse section through the colon (B.M., basement membrane; C.F., contractile fibrils; C.T. connective tissue; S, sarcolemma of the circular muscles; other lettering as in Figure 16),  $\times 293$ . — Fig. 18 : Longitudinal section through the junction of the colon and rectum (C, canalicule leading from the cavity of the gut into the fascial chamber; EP.C., colon-epithelium; EP.R., rectum-epithelium; INT.C., intima of colon; INT.R., intima of rectum; P, pores in the intima between colon and rectum; other lettering as in Figure 16),  $\times 500$ . — Fig. 19 : Portion of transverse section through the junction of the colon and rectum (EP, epithelium; INT, intima; other lettering as in Figure 18),  $\times 500$ .



The muscularis is composed only of a thin circular muscle layer (C.M.). Its sarcolemma (S) is widely separated from the contractile fibrils (C.F.) which are grouped in the middle of the sarcomeres. The nuclei of the muscle layer are abundant, and are disposed between the sarcolemma and the contractile fibrils. The spaces between the epithelial folds are filled with a somewhat loose connective tissue (C.T.). In the colon region, the fascia (FAS) is comparatively broad, and with a large number of small nuclei. Due to their great coiling on the outer surface of the colon, the Malpighian tubes (M.T.) appear more than six in number in the cross-section. The fascial chamber (CH), in which they are enclosed is largely granulated and is filled with loose connective tissue and blood.

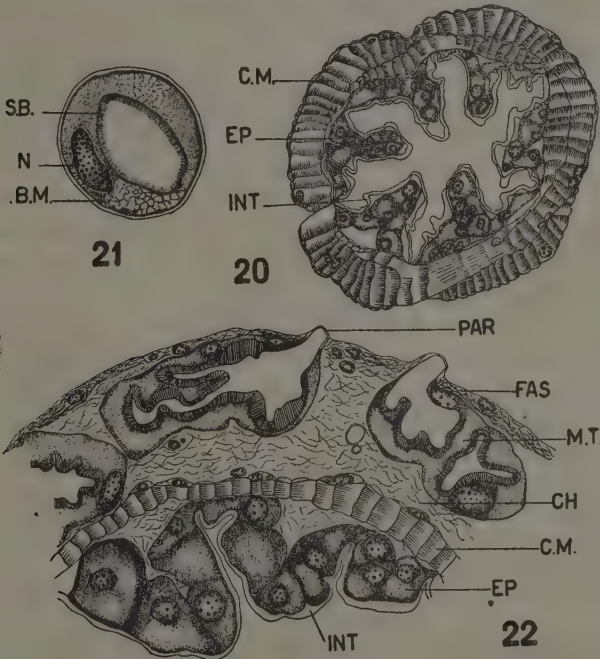


Fig. 20 : Transverse section through the rectum (lettering as in Figure 17),  $\times 293$ . — Fig. 21 : Transverse section through the Malpighian tube (B.M. basement membrane; N, nucleus; S.B., striated border),  $\times 500$ . — Fig. 22 : Portion of a transverse section through the colon, much enlarged (PAR, partition between the Malpighian tube and the general body cavity; other lettering as in Figure 18),  $\times 500$ .

Just above the junction between the colon and the rectum, the circular muscles of the colon end. At this region (Figs. 18 and 19) the fascial muscles (Fig. 19, CH), round the Malpighian tubes (Fig. 18, M.T.), communicates with the cavity of the gut by very minute pores (Figs. 18 and



19, P), found on the intima, just above the insertion of the fascia (FAS) on it. These pores (P) lead into minute narrow canaliculi (C) which occur between the epithelial cells of this region (Fig. 18, EP). A cross-section in this transitional region (Fig. 19) shows the posterior part of the fascial chamber (CH) enclosed externally by the fascia (FAS) and internally by the epithelium (EP). The intima (INT) in this region is relatively thin and the minute pores (P) lead from the cavity of the gut into the fascial chamber (CH) by means of the canaliculi (C).

Similar pores were recognized by Landis (1936) round the junction of the colon and rectum of *Ceratomegilla fuscilabris* Muls. Pradhan (1942) described these pores from *Coccinella septempunctata* L. and *Epilachna indica* Muls. According to the latter author, these pores establish a luminal connection between the lumen of the hind-gut and the body cavity through the fascial envelope. Through this connection the water from the excreta, stored in the colon, is pressed out again into the fascial chamber, where it is first cleaned in the re-associated part of the Malpighian tubes and then flows back again to the body cavity.

#### d. Rectum

The posterior intestine or rectum (Fig. 20) is about the same diameter as that of the ileum. The six longitudinal folds of the rectum are more projecting into the lumen. Also the intima (INT) is relatively more developed, and is separated at some parts from the epithelium (EP). The epithelial cells are relatively small, and the cell divisions are only visible under the high power of magnification. The nuclei are comparatively small, with but a few number of chromatin granules. The cytoplasm is homogenous and finely granulated.

The most outstanding feature of the rectum lies in the fact that the circular muscles (C.M.) are well developed, and always occur in more than one layer. There is no longitudinal muscle layer, the muscularis being formed only by the circular muscles.

#### e. Malpighian tubes

The six Malpighian tubes originate from in between the junction of the mid-gut (Fig. 12, M.G.) and the hind-gut (H.G.), just above the pyloric sphincter. They run various distances in the body cavity and then turn back, and finally come to lie close to the wall of the hind-gut. At the junction of the ileum and colon, their distal portions enter the fascial envelope, which surrounds the colon. They are much coiled and lie over the entire surface of the colon. They end blindly within the fascial envelope, near the junction of the colon and rectum.

In cross-section, each Malpighian tube (Fig. 21) is seen to consist of two to three epithelial cells surrounding a central cavity. In nearly all the

sections of the Malpighian tubes examined, the cell partitions were not distinct. The large nuclei of the epithelial cells are round or oval and contain large and numerous chromatin granules. The cytoplasm is coarsely granulated and rectangular in nature. The epithelial cells rest upon a well defined and somewhat broad basement membrane (B.M.), which forms the external covering of the tube.

The inner border of the epithelial cells is distinctly striated, and carries cilia-like processes (S.B.). The length and the shape of this border vary much according to the physiological condition of the cells.

At some parts in the region of re-association, the Malpighian tubes (Fig. 22, M.T.) touch the covering fascia (FAS). There, the epithelial lining together with the striated border and the basement membrane disappear, and the only structure left is a very thin partition (PAR) formed by the fascia, and separates the cavity of the tube from the general body cavity.

Similar projections were described from the Malpighian tubes of the Coccinellid beetle *Adalia bipunctata* L. (Conet 1934). According to this author, these projections of the re-associated part of the Malpighian tubes may facilitate the exchange of water between the cavities of the tubes and the general body cavity.

### III. REFERENCES

- Burgess, E.D. (1932) : A comparison of the alimentary canals of the active and hibernating adults of the Mexican bean-beetle "*Epilachna corrupta* Muls." (*Ohio Jour. Sc.*, 32, pp. 249-261).
- Conet, A. (1934) : Contribution à l'histologie des tubes de Malpighi des Coléoptères cryptonephridés (*Ann. Soc. Sc. Bruxelles*, Louvain, (B) 54, pp. 189-200).
- Landis, B.J. (1936) : Alimentary canal and Malpighian tubules of *Ceratomyella fuscilabris* Muls. [Coccinellidae : Coleoptera] (*Ann. Ent. Soc. Amer.*, 29, pp. 15-27).
- Lison, L. (1938) : Sur la structure et l'histophysiologie des tubes de Malpighi chez le doryphore "*Leptinotarsa decemlineata*" (*C.R. Soc. Biol. Paris*, 129, pp. 873-875).
- Patay, R. (1937) : Anatomie, histologie et physiologie des tubes de Malpighi du doryphore "*Leptinotarsa decemlineata* Say" [Chrysomelidae : Coleoptera] (*Bull. Soc. Zool. France*, Paris, 62, pp. 174-186).
- Potts, S.E. (1927) : The alimentary canal of the Mexican bean-beetle (*Ohio Jour. Sc.*, 27, pp. 127-137).

- Pradhan, S. (1936) : The alimentary canal of *Epilachna indica* [Coccinellidae : Coleoptera], with a discussion on the activity of the mid-gut epithelium (*J.R. As. Soc. Bengal Sc.*, 2, No. 2, pp. 127-156).
- Pradhan, S. (1939) : The alimentary canal and pro-epithelial regeneration in *Coccinella septempunctata*, with a comparison of carnivorous and herbivorous Coccinellids (*Quart. J. Micr. Sci.*, 81, pp. 451-478).
- Pradhan, S. (1942) : Re-association of the Malpighian tubules in Coccinellid beetles (a hydro-filter device for water-conservation) (*Indian J. Ent.*, New Delhi, 4, part 1, pp. 11-21).
- Snodgrass, R.E. (1935) : Principles of insect morphology (McGraw-Hill Book Company, New-York and London).
- Wigglesworth, V.B. (1930) : Formation of the peritrophic membrane in insects (*Quart. J. Micr. Sci.*, 73, pp. 593-616).
- Wigglesworth, V.B. (1947) : The principles of insect physiology (Methuen and Co. Ltd., London).
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# A contribution to the study of reproduction in the bed-bug (*Cimex lectularius* L.)

[ Hemiptera-Heteroptera ]

(with 7 Text-Figures and 8 Tables)

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## I. INTRODUCTION

Among insects the unique mode of insemination of the bed-bug and allied species of the sub-family Cimicinae has attracted the attention of so many authors. Berlese (1893) was the first author to describe the act of copulation and sperm transference in the bed-bug and discovered the peculiar organ which bears his name and known as "the organ of Berlese". This is situated on the right side of the abdomen of the female insect in the region of the fourth and fifth sternites. Through this organ the sperm from the male insect pass into the female's body-cavity and find their way to the spermathecae. The organ of Berlese opens to the outside by a short longitudinal slit on the apparent fourth sternite. This entrance was observed by Ribaga years before this organ was described and its function known. So the name "Ribaga's organ" is sometimes retained and given to the structure which constitute the entrance to the organ of Berlese, and into which the penis is inserted and the sperm are ejected.

Other than the ordinary bed-bug, Jordan (1922) found that the organ of Berlese is present in all the species of *Cimex* L. (*Clinocoris* Fall.) : *columbarius*, *hemipterus* (*rotundatus*), *pilosus*, *pipistrelli*, *dissimilis*, *peris-*

*terae* and in some other unidentified bugs. In all these species the slit is always in the same place although there is a considerable variation in its depth and general outline in some of them. In *Cacodmus villosus* and *Haematosiphon inodorus* (Clinocoridae) he found that the female insect bears on the dorsal side of the fifth abdominal segment an organ which externally resembles that of Ribaga, but it is situated on the left side in the former and on the middle of that tergum in the latter. In both these two species, however, detailed study of this organ is lacking and there is no evidence to warrant the function which is performed by the same organ in *C. lectularius*. It is worth noting that Abraham (1934) did not find any similar organ in any of the species he examined of Anthocoridae which is a closely related family to Cimicidae.

Cragg (1921) showed that the organ of Berlese may be occasionally present on both sides of the female's abdomen. Abraham (1934) confirmed Cragg's observation and found in three lots of female bed-bugs that 2.16, 15.4 and 37.9% of the insects had paired organs. But in all his dissections he never found the left organ to be functionally active or containing any sperm. This may be due to the naturally curved penis which is adapted to deliver the sperm to the right organ, and that the position of the male's body during copulation (which always lies on the right side of the female's abdomen) prevents the delivery of sperm to the left organ.

Several accounts have been given of the curious fate of sperm inside the female's body. All authors agree that the female reproductive organs of the bed-bug are morphologically and physiologically different from those of other insects. The walls of the spermathecae, the anterior part of the unpaired oviduct, the vagina, and the ovarioles are not lined by a sclerotized layer. Moreover, the sperm, having passed through Berlese's organ and reached the posterior part of the reproductive organ, penetrate the walls of the spermathecae at their junction with the common oviduct. They also penetrate the walls of the vagina and wander in its lumen to find their way to the spermathecae where they are stored. From these two organs the sperm migrate, intercellularly or intracellularly, through the walls of the lateral oviducts. But where the eggs are fertilized is unknown; Cragg (1921) and Abraham (1934) are of the opinion that fertilization takes place in the ovarioles before the chorion is laid down and when the eggs are very small, as they observed that the sperm occurred in great numbers in the follicular epithelium. It has been proved by Beament (1946), however, that in the case of the bug *Rhodnius prolixus* Stål the fertilization of eggs is independent of the formation of the chorion, and it has long been known that the micropyles of most insect eggs play a vital part in fertilization as it is the only access of sperm into the eggs.



The organ of Berlese is said to produce some internal secretion which it discharges into the blood when the sperm pass through it. Presumably this secretion serves to activate the sperm, as this was proved when they showed an active movement in Ringer solution when derived from the organ of Berlese a short time after copulation or from the haematocele nearly four hours after copulation, or from the spermathecae soon after they have reached there. On the other hand sperm derived from the vesicula seminalis of the male were motionless or showed very little movement in the solution, and also those sperm which have stayed in the spermathecae for more than two hours.

Abraham (1934) showed that the sperm migrate towards the spermathecae, perhaps, by chemotaxis. He placed some sperm from the body cavity in a drop of Ringer solution on a slide and added parts of different tissues, viz., the spermathecae, the common oviduct, the vagina, the paired oviduct and the ovary; he found that the sperm move lively towards the parts of the tissues when these were taken from the spermathecae or the common oviduct, and the distance was not more than 1 mm. Other tissues did not exert such movement even when the distance between them and the sperm was 0.5 mm.

Wigglesworth (1936) has shown that in the bug *Rhodnius prolixus* Stål, ovarian development is dependent on the secretion of a special hormone produced by the corpus allatum, an organ of internal secretion associated with the brain. This organ is stimulated to secrete when the female takes a blood-meal. Other than ovarian development, he has also shown that moulting and metabolism are controlled by perhaps the same substance in both *Rhodnius* and *Cimex*, and that the hormone controlling these processes in one species can induce the same changes in the other. The only fundamental difference between the egg-laying behaviour of the two species is that the ovaries in a virgin *Rhodnius* will develop and she will go on laying sterile eggs when she takes a blood-meal, whilst in a fed virgin *Cimex* the ovaries do not develop and there is no egg production unless she is fertilized. When a virgin female *Cimex* or *Rhodnius* is fertilized but kept unfed there is no ovarian development and no eggs are produced.

It has been shown by Jones (1930), however, that in the case of *Cimex* a fertilized female will lay eggs before feeding in the adult stage. But such females must have had sufficient food in the mid-gut when transformed from the fifth nymphal instar to the adult stage. Johnson (1942) states that if bugs are bred at 28° C. with two feeds per week, the adults are large and are able to lay appreciable numbers of eggs before they have fed as adults. This may support Wigglesworth's opinion that

moulting and ovarian development are controlled by the same hormone in some insects.

It is clear, therefore, that in *Cimex* egg-production is usually dependent on both feeding and fertilization; and that, other than fertilizing the eggs, the sperm inside the female's body are involved, in a way still unknown, in ovarian development. It is worth noting that mammalian spermatozoa contain a supplementary substance, an enzyme (hyaluronidase), which is essential for the process of fertilizing the ova (Rothschild 1947).

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In addition to the above mentioned functions of sperm in the bed-bug Berlese has put forward his theory ~~by~~ "hypergamesis" which was confirmed later by Cragg (1921) and Abraham (1934); but there is still some disagreement concerning this point. Under the term "hypergamesis" Berlese included two distinct phenomena, viz., the stimulus to the development of the reproductive organs which is provided by the sperm (and this has been confirmed experimentally by other workers) and the utilization of the excess of the sperm as nourishment for the female. And although this was confirmed by the above mentioned workers it has not been possible to obtain any direct evidence of the nutritive value of these sperm in the impregnated female bed-bug.

According to Berlese the excess of sperm are taken up and digested during the oviposition period by the cells of the spermathecae, those of the special organ which bears his name and the epithelial cells of the oviduct. This was not observed by Cragg; he presumed that the sperm are in some unknown way disposed with in the ovarioles during the period when the follicular cells are producing the chorion and the nurse cells supplying the ovum with its yolk. He also found that the sperm do not remain intact during the period when the reproductive function is suspended by starvation, as egg-production was greatly reduced in proportion to the length of the intervals between meals. And although there is no quantitative evidence on the point he presumed that the sperm might be used as an additional nourishment during the period of starvation.

Abraham (1934) studied particularly the fate of the sperm inside the female's body. Some of the sperm, he states, are absorbed in the cellular organ of Berlese, some by phagocytes (spermatophagen), in the body cavity, some in the basal part of the ovarioles and in the *corpora lutea*, but most are digested in the spermathecae which are referred to as absorptive organs (Resorptions-organen). He found that the sperm are disintegrated 8-10 days from copulation and after 1-2 weeks neither the sperm nor their products are to be seen in the absorptive organs. In the lumen of these organs he found that the sperm are taken up and digested by some free cells, phagocytes, which originate from their walls, and this absorption is considered

necessary for proper ovarian development. But Mellanby (1939) cannot accept this conclusion, for masses of living sperm are found in the spermathecae several weeks after copulation and he undoubtedly regards these organs to preserve the sperm alive in the usual manner. My following observations will agree with Mellanby's findings, and it is worth noting that in the case of the bug *Rhodnius prolixus* Stål although the sperm are kept alive and active in the spermathecae but unable to fertilize the eggs towards the end of the fertile period (Khalifa 1950), they never undergo disintegration and thus "hypergamesis" does not occur.

## II. METHODS

The methods adopted throughout this work were simple. All experimental bugs were bred either singly or in pairs in glass tubes from the egg stage, or from the advanced nymphs which were removed from the general stock when about to moult and placed in a separate tube in order to ensure that copulation did not occur before the experiment was begun. Most of the tubes were 2×1 inches, and their open ends were covered by gauze; a piece of blotting paper was inserted in every tube on which the insects rested and laid their eggs, and at intervals of a few days or a week the blotting paper was replaced by a fresh one. The bugs were fed throughout on rabbit, and were kept, except in one experiment (see page 329) in an incubator at 28-31° C. <sup>(1)</sup>, and 60-70% relative humidity. In all experiments the age of the bugs and the number of times they had been fed after the final moult was noted.

The tubes used for keeping the bugs would seem to provide them with rather a confined space, but it has been found from the outset of this work that the space has no relation with the general egg output; nor would this confined space be unnatural for the resting bugs. The greater part of the time of a bed-bug's life is spent in a state of immobility, usually in corners, cracks and crevices in rooms or in furnitures. This inhibition of movement, so characteristic of *Cimex* and other insects such as earwigs, is brought about by contact stimuli. When a bed-bug comes to rest it brings as much of its surface area (or rather as many of its tactile receptors) as possible into contact with adjacent surfaces, whether these be the sides of a crack or the bodies of other bugs, "stereokinesis" or "thigmotaxis". And when the insects' tactile receptors are sufficiently stimulated, the state of immobility is maintained until other sorts of stimuli occur to induce the bug to wander about.

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<sup>(1)</sup> Electricity cut is not uncommon in Shebin El-Kom, but being for short intervals would not affect the results. Moreover, during the summer months the room temperature is always as high as that of the incubator.

It may be thought, moreover, that humidity, being not strictly controlled, may introduce variation in egg output. But it has been shown by Johnson (1942) that humidity has no effect on egg-production. He compared the egg-production of bugs kept at 10% R.H., with that of bugs kept at 90% R.H. (both at 23°C.) and found no significant difference in the mean number of eggs produced from a single blood-meal.

With regard to the host used in feeding bugs in the present work, it is known that the usual host for *C. lectularius* is man, but the insect can feed and reproduce on many other warm-blooded animals. The feeding experiments described by Johnson (1937) show that the life of the bed-bug, unlike that of some other blood-sucking arthropods (mosquitoes, lice and ticks), is not much affected when the insect is fed on certain animals other than the habitual host. Among the warm-blooded animals fowls, rats, mice, guinea-pigs and rabbits may also serve as successful hosts. Fowl and rabbit houses attached to dwelling places are not uncommonly infested, and the infestation is frequently very great indeed. Johnson showed that under laboratory condition larger meals are taken from mouse (probably on account of its high body temperature) than from man or other hosts, and it is this presumably which induces a relatively rapid developmental rate. Perhaps for this reason too that the mouse-bred adult bugs were characterized by a slight increase in fecundity. As far as cold-blooded animals are concerned the bed-bug does not use them as hosts under natural condition. But Rivnay (1930) has shown that when the heat which the reptiles give off is preserved or is artificially raised 2°C. beyond that of the environment; when a scaleless surface is offered to them such as between the toes; and when the moisture is removed from the skin of the amphibians, the bed-bugs freely feed upon these animals.

### III. THE GENERAL EGG-LAYING BEHAVIOUR

Anyone who has worked with *Cimex* will have noticed that copulation is repeatedly performed and is a common occurrence in the culture. This frequency of copulation has been found to have a bearing on the ability of females to maintain their fertility. Insects will have a short period (2 or 3 days) immediately after the last ecdysis during which they become sexually mature. Males after that period will have their vesiculæ seminales full of sperm, the accessory glands will be fully developed and their reservoirs full of a transparent secretion. Sexual activity may commence before the insects will have their first meal.

When fertilized and fed, the female bed-bug lays two kinds of eggs: fertile eggs which usually hatch after 5 days from oviposition under the conditions mentioned above, and sterile or unfertilized eggs which shrivel



up and collapse soon after oviposition. The latter have been described by Mellanby (1939) and Cragg (1923) as "imperfect" or "malformed" and termed "taub" eggs by the German authors. It has been found that a female will lay a very small number of sterile eggs at the beginning of her fertile period, but they appear in high proportion towards the end as the sperm in the spermathecae become exhausted. A fertile egg usually gets darker in colour and shows two red eye-spots near the operculum two days after oviposition. The appearance of these eye-spots has been taken as an indication of fertility as a very small number of such eggs will fail to hatch. Some eggs appeared to be normal 1 or 2 days after oviposition but no eye-spots developed because the embryos had died in such an early stage. They will collapse and get dark in colour 3 or 4 days after oviposition. These eggs will be considered as fertile ones.

The shrivelling up of the sterile eggs soon after oviposition is, presumably, due to desiccation. They cannot be distinguished in the ovaries, and will maintain their normal shape for some time after being laid if kept in a saturated atmosphere. In dry air, however, the eggs soon collapse, as the chorion is presumably not perfectly water-proofed. The water proofing mechanism occurs while the eggs are still in the ovaries and it is the maturing oocyte which is responsible for secreting the wax layer along the inner surface of the chorion.

Bugs will lay sometimes another type of eggs which do not hatch. They are usually smaller in size than the ordinary ones, much narrower, darker in colour, do not show the eye-spots, and therefore they are considered as sterile ones. Their shells were certainly water-proofed as they never collapsed.

Any fertilized female bug brought from a natural infestation will produce a batch of eggs comprising a varying number of them (3-8). Then there will be a complete cessation of oviposition, and when dissected the ovaries will be found to contain no eggs; this condition will be maintained until a blood-meal is taken. As soon as the female is fed, ovarian development is resumed, and a certain period will elapse before the eggs are ready to be laid. This period is termed by Mellanby (1939) "a latent period", and he states without giving his records that it is shorter at higher than at lower temperatures. In the present work, however, the "latent period" was found to vary considerably not only among the different bugs but also after meals taken by the same bug despite the fact that all bugs were kept constantly under the same temperature (see Fig. 4). As a result of examining 11 latent periods of bugs fed at an interval of 14 days it was found to be 4 days in 3 cases, 3 days in 5 and 2 days in 3 (mean 3 days). But when bugs were fed at an interval of 7 days the latent period was found to be 4



days in one case (out of 15), 3 days in 5, 2 days in 7 and there was no latent period at all on 2 cases (mean 2.2 days).

When a virgin female is fed and then fertilized soon after feeding the eggs do not begin to develop until about 24 hours later, by which time the sperm have migrated from the organ of Berlese to the spermathecae. The right spermatheca was found to be filled with sperm 12-15 hours after copulation, at which time the left one was found to contain a few number of sperm and the body cavity still contains masses of them. The length of the latent period which elapses before the beginning of oviposition was examined in 9 cases and found to be 3 days in one case, 4 days in 3, 5 days in 2 and 6 days in 3 cases (mean 4.7 days).

This difference in the length of the latent period together with the considerable variation between the egg output of individual females, as will be shown later, may be expected in an insect like *Cimex*. Johnson (1942) has shown that individual females vary in size, nourishment during development, and the size of the blood-meal from which eggs are produced. In such a case it is not justifiable, therefore, to make generalizations unless a reasonable number of cases is examined. It has been contended by Buxton (1930), for instance, that fertility in *Rhodnius prolixus* Stål is comparatively affected when males used in fertilization are starved; a well fed male, he stated, may be able to deliver more sperm to the female than a starved one. He went further and said that this may be applicable to other insects like the bed-bug. This was the opinion of Cragg (1923) who thought that a well-nourished male copulated once with a female caused her to produce more fertile eggs than when fertilized by an under-fed one. He deduced this fact from experiments carried out on a very limited number of insects. Counting the eggs produced by two well nourished females of *Cimex* mated with unfed males he found that they produced an average of 45.5 fertile and 12 sterile eggs. But when he used females mated with males which had been recently fed he found the average to be 137 fertile and 29 sterile eggs; and this was the result of an experiment carried out on four females only. In *Rhodnius*, however, it has been shown by Khalifa (1950) that males starving for 21-28 days are not less efficient than recently fed ones, and it will be shown in the present work that this is exactly the case in the bed-bug also.

#### IV. THE EFFECTIVE LENGTH OF A SINGLE COPULATION

When males and females are fed and allowed to remain together in a tube copulation generally occurs immediately as insects become close to one another. All authors agree that one impregnation does not enable the female to lay her full complement of eggs. Copulation must be repeated so many

times if the female is to go on laying without undergoing a sterile period, provided of course that blood-meals are offered frequently. In the present work virgin well fed females and recently emerging males which have never copulated before were used. Some males were allowed to impregnate the females soon after they were fed to repletion, but the others were similarly fed for once only and allowed to impregnate the females after they underwent a period of starvation of a varying length of time. This experiment was designed in order to show if starved males were sexually less efficient than recently emerged fed ones. The numbers of fertile and sterile eggs produced by females inseminated by starving males, together with those obtained from a control series of females inseminated by recently fed males are given in Tables I and II.

TABLE I

*Number of eggs produced by females paired  
with starving recently emerged males*

| FEMALE    | DATE OF FEEDING<br>AT THE OUTSET<br>OF THE<br>EXPERIMENT |              | PERIOD<br>OF STARVATION<br>OF MALES (IN DAYS) | DATE<br>OF<br>MATING | LENGTH<br>OF FERTILE<br>PERIOD (IN DAYS) | NUMBER OF FEEDS<br>TAKEN DURING<br>FERTILE PERIOD (a) | NUMBER<br>OF FERTILE EGGS | NUMBER<br>OF STERILE EGGS |
|-----------|----------------------------------------------------------|--------------|-----------------------------------------------|----------------------|------------------------------------------|-------------------------------------------------------|---------------------------|---------------------------|
|           | Female                                                   | Male         |                                               |                      |                                          |                                                       |                           |                           |
| G G ..... | 7.I .51                                                  | 30.XI .50    | 38                                            | 7.I .51              | 38                                       | 3                                                     | 26                        | 2                         |
| H H ..... | 7.I .51                                                  | 6.XII.50     | 32                                            | 7.I .51              | 77                                       | 7                                                     | 42                        | 6                         |
| I I ..... | 17.I .51                                                 | 14.XII.50    | 34                                            | 17.I .51             | 43                                       | 3                                                     | 25                        | 13                        |
| J J ..... | 29.I .51(b)                                              | 30.XI .50(c) | 56                                            | 25.I .51             | 59                                       | 7                                                     | 47                        | 11                        |
| W W ..... | 5.IV.51                                                  | 28.II .51    | 43                                            | 12.IV.51             | 53                                       | 6                                                     | 58                        | 3                         |
| X X ..... | 5.IV.51                                                  | 28.II .51    | 43                                            | 12.IV.51             | 41                                       | 5                                                     | 55                        | 9                         |
| Y Y ..... | 26.IV.51                                                 | 17.III .51   | 46                                            | 2.V .51              | 56                                       | 7                                                     | 66                        | 4                         |
| Z Z ..... | 26.IV.51                                                 | 17.III .51   | 52                                            | 8.V .51              | 36                                       | 3                                                     | 40                        | 3                         |
| A .....   | 26.IV.51                                                 | 17.III .51   | 46                                            | 2.V .51              | 49                                       | 8                                                     | 51                        | 10                        |
| MEAN..... |                                                          |              |                                               |                      | 50.2                                     | 5.4                                                   | 45.6                      | 6.8                       |

(a) Every female was offered a blood-meal once a week approximately, but many of them refused to feed so regularly.

(b) This female was offered a blood-meal on 25.I.51, but refused to feed.

(c) This male was used for a second time during its period of starvation. It was used for the first time to impregnate female G G when it was starving for 38 days. It is worth noting that female J J remained fertile for a longer period and produced more eggs than G G. This is certainly due to the fact that female J J had 4 more blood-meals than female G G.

The conclusions which can be drawn from these observations are that :  
(1) a single copulation enables the female to produce fertile eggs during a limited period which is termed the "fertile period", the mean of which

is nearly the same in the two sets of females, 50.2 and 50.3 days; (2) the mean number of fertile eggs produced by the first set of females approximates that of the second set, 45.6 and 46.4 eggs respectively, the difference is not significant; (3) during the fertile period the females of the first set seemed to produce more of the sterile eggs than those of the second set, the average was 6.8 in the former and 3.5 in the latter. With regard to the males it appeared that during copulation neither the well fed nor the starved ones delivered more than one fifth of the whole contents of the vesiculæ seminales. Copulation by starved males may take a longer period

TABLE II

*Number of eggs produced by females paired  
with well fed recently emerged males*

| FEMALE                                                                                                              | DATE OF FEEDING<br>AT THE OUTSET<br>OF THE<br>EXPERIMENT |            | DATE<br>OF<br>MATING | LENGTH<br>OF FERTILE<br>PERIOD (IN DAYS) | (A) NUMBER<br>OF FEEDS | NUMBER<br>OF FERTILE EGGS | NUMBER<br>OF STERILE EGGS<br>LAID DURING<br>FERTILE PERIOD |
|---------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|------------|----------------------|------------------------------------------|------------------------|---------------------------|------------------------------------------------------------|
|                                                                                                                     | Female                                                   | Male       |                      |                                          |                        |                           |                                                            |
| M .....                                                                                                             | 28.X .50                                                 | 28.X .50   | 28.X .50             | 47                                       | 4                      | 48                        | 4                                                          |
| N .....                                                                                                             | 28.X .50                                                 | 29.X .50   | 29.X .50             | 60                                       | 7                      | 53                        | 4                                                          |
| O .....                                                                                                             | 9.XI .50                                                 | 9.XI .50   | 9.XI .50             | 56                                       | 5                      | 50                        | 4                                                          |
| R .....                                                                                                             | 9.XI .50                                                 | 9.XI .50   | 9.XI .50             | 35                                       | 3                      | 42                        | 1                                                          |
| T .....                                                                                                             | 9.XI .50                                                 | 9.XI .50   | 9.XI .50             | 56                                       | 5                      | 61                        | 3                                                          |
| U .....                                                                                                             | 18.XI .50                                                | 19.XI .50  | 19.XI .50            | 48                                       | 5                      | 57                        | 1                                                          |
| V .....                                                                                                             | 30.XI .50                                                | 30.XI .50  | 30.XI .50            | 37                                       | 3                      | 20                        | 0                                                          |
| X .....                                                                                                             | 29.XI .50                                                | 29.XI .50  | 30.XI .50            | 56                                       | 5                      | 43                        | 0                                                          |
| Y .....                                                                                                             | 30.XI .50                                                | 30.XI .50  | 30.XI .50            | 37                                       | 2                      | 18                        | 6                                                          |
| BB .....                                                                                                            | 28.XII.50                                                | 28.XII.50  | 31.XII.50            | 45                                       | 4                      | 30                        | 4                                                          |
| QQ .....                                                                                                            | 17. III.51                                               | 17. III.51 | 17. III.51           | 61                                       | 7                      | 50                        | 5                                                          |
| RR .....                                                                                                            | 17. III.51                                               | 17. III.51 | 17. III.51           | 66                                       | 9                      | 85                        | 10                                                         |
| MEAN.....                                                                                                           |                                                          |            |                      | 50.3                                     | 5                      | 46.4                      | 3.5                                                        |
| (a) Every female was offered a blood-meal once a week approximately, but many of them refused to feed so regularly. |                                                          |            |                      |                                          |                        |                           |                                                            |

that normal, 10 minutes or more as against half a minute or less when males are fed. The other parts of the male reproductive system, viz., the accessory glands and their reservoirs do not undergo a marked change in either the well fed or the starved males.

Moreover, this experiment shows that there are some other points which are common for both sets of females. The considerable variation between the egg output of individual females known to have received the same number of blood-meals is shown quite clearly when we consider females HH, JJ, and YY of the first set. They all had the same number

of feeds, viz., 7 blood-meals and produced a varying number of fertile eggs : 42, 47 and 66 respectively. This is also clear in females O, T, U and X of the second set. Each female had 5 blood-meals but the numbers of fertile eggs were 50, 61, 57 and 43 respectively. This is presumably due to the difference in weight of the blood-meals the females have taken and to the difference in nourishment during their nymphal instars; or it may be due to hereditary characters.

The length of the fertile period seems to be in direct proportion with the number of blood-meals the female has taken; the greater the number of feeds the longer is the fertile period. This is shown in Table III and Fig. 1.

TABLE III

*The relationship between the number of feeds  
and the length of the fertile period*

| (a) FEMALES OF THE FIRST SET       |    |    |    |    |    |    |    |    |    |
|------------------------------------|----|----|----|----|----|----|----|----|----|
| FEMALE                             | GG | II | ZZ | XX | WW | HH | JJ | YY | A  |
| Number of feeds                    | 3  | 3  | 3  | 5  | 6  | 7  | 7  | 7  | 8  |
| Length of fertile period in days.. | 38 | 43 | 36 | 41 | 53 | 77 | 59 | 56 | 49 |
| MEAN ....                          | 39 |    |    |    |    |    | 64 |    |    |

| (b) FEMALES OF THE SECOND SET      |    |    |    |    |    |    |    |    |    |      |    |    |
|------------------------------------|----|----|----|----|----|----|----|----|----|------|----|----|
| FEMALE                             | Y  | R  | V  | M  | BB | O  | T  | U  | X  | N    | QQ | RR |
| Number of feeds                    | 2  | 3  | 3  | 4  | 4  | 5  | 5  | 5  | 5  | 7    | 7  | 9  |
| Length of fertile period in days.. | 37 | 35 | 37 | 47 | 45 | 56 | 56 | 48 | 56 | 60   | 61 | 66 |
| MEAN ....                          | 36 |    |    | 46 |    | 54 |    |    |    | 60.5 |    |    |

Furthermore, it seems that the number of fertile eggs is generally in direct proportion with the number of blood-meals a female has taken during her fertile period. This is clear when we consider female GG, XX, and YY of the first set. The numbers of fertile eggs are 26, 55 and 66, and the numbers of meals are 3, 5, and 7 respectively. In the second set this is clear when the following data are considered (Table IV).

But there were some aberrant females which did not follow this rule. Females YY and A of the first set, for instance, gave 66 and 51 fertile eggs although they received 7 and 8 blood-meals respectively. This is also clear when females U and QQ of the second set are considered. They laid

57 and 50 fertile eggs although they received 5 and 7 blood-meals respectively. This is certainly due to some individual variations because it will be shown later that the result of increasing the frequency of feeding is the increase of the general level of egg production and shortening or eliminating the latent period.

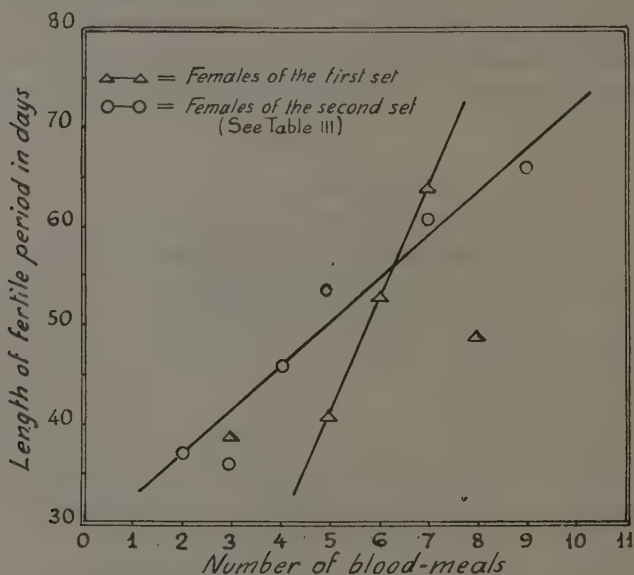


Fig. 1 : The relationship between the number of feeds and the length of the fertile period in females known to have impregnated once only.

TABLE IV

*The relationship between the number of feeds  
and the production of fertile eggs*

| FEMALE                    | Y  | V  | BB | X  | N  | RR |
|---------------------------|----|----|----|----|----|----|
| Number of feeds .....     | 2  | 3  | 4  | 5  | 7  | 9  |
| Number of fertile eggs... | 18 | 20 | 30 | 43 | 53 | 85 |

#### V. BREAKING THE STERILE PERIODS BY FURTHER COPULATIONS

The previous females underwent a period of fertility for a varying length of time during which they laid fertile eggs and a small percentage of



sterile eggs. If such females were dissected when the fertile period had expired the spermathecae were found empty and the ovaries to contain no ripe eggs. The ovarian development resembled that of a virgin female. There was also another striking difference with regard to metabolic rate. During the fertile period the blood was digested much more rapidly than in a female undergoing a sterile period. In a fertilized female much of the nourishment goes in egg production and some is exhausted because of the greater rate of metabolism, and so a fertile female is apt to feed more frequently than a sterile one. If a sterile or a virgin female is fed to repletion digestion will go on very slowly and in a week's time no marked difference can be observed in the size of the engorged abdomen, and so feeding will mostly not occur. Mellanby (1939) found that the gut of a virgin female 7 days after feeding is about as full as that of a fertilized female after 2 days.

As mentioned before the sterile eggs appear in a considerable number towards the end of the fertile period, and at the outset of the sterile period. In some cases they do not appear at all during the sterile period (see female O: Table V, and Fig. 2). An attempt to break the sterile periods of 10 females (each was inseminated once) by further matings was undertaken. The egg-laying behaviour of five of them is shown in Table V and the Graph (Fig. 2) represents that of one female only.

It was found that a new supply of semen broke the sterile period and renewed the output of fertile eggs of five females. The sterile period of two of the other five females was broken by the production of one fertile egg only, while that of the other two did not break at all. The remaining female died after 14 days from her association with the male and did not produce any egg.

It is difficult to account for the failure in breaking the sterile period of some of the above mentioned females. But when dissected the body cavity was found to contain much of a reserve of fat and the ovaries no eggs, although some of them had their spermathecae full of sperm which showed some movement in Ringer solution. Most of the nourishment, therefore, went in producing the reserve of fat instead of producing eggs under normal conditions. It is perhaps the change of metabolic rate as a result of suppressing the ovarian development (during the sterile period which was maintained in one female for 151 days) that caused the hormone responsible for stimulating the ovaries not to be secreted in a sufficient quantity or not to be secreted at all when a second supply of sperm is delivered.

In some of the males used in mating to break the sterile periods, on the other hand, the reproductive system showed some peculiarities. The tubular follicles of the testes were found to contain no sperm but occupied by a fine granular secretion. At the point where the testis joined the vas

TABLE V  
*Breaking the sterile periods by further copulations*

| FEMALE | DATE OF FIRST COPULATION | DURATION OF FERTILE PERIOD IN DAYS | NUMBER OF FERTILE EGGS | NUMBER OF STERILE EGGS LAID DURING FERTILE PERIOD | NUMBER OF FEEDS | DURATION OF FERTILE PERIOD IN DAYS (a) | NUMBER OF STERILE EGGS | DATE OF SECOND MATING | DURATION OF SECOND FERTILE PERIOD IN DAYS | NUMBER OF FERTILE EGGS | NUMBER OF STERILE EGGS | NUMBER OF FEEDS |
|--------|--------------------------|------------------------------------|------------------------|---------------------------------------------------|-----------------|----------------------------------------|------------------------|-----------------------|-------------------------------------------|------------------------|------------------------|-----------------|
| IL.... | 17. I. 1951              | 43                                 | 25                     | 13                                                | 3               | 97                                     | 1                      | 6. VI. 1951 (b)       | 34 (d)                                    | 33                     | 1                      | 3               |
| LL...  | 25. II. 1951             | 11                                 | 5                      | 6                                                 | 1               | 90                                     | 12                     | 6. VI. 1951 (b)       | 47 (e)                                    | 18                     | 4                      | 5               |
| QQ...  | 17. III. 1951            | 61                                 | 50                     | 5                                                 | 7               | 41                                     | 2                      | 27. VI. 1951 (b)      | 33 (f)                                    | 19                     | 2                      | 5               |
| WW...  | 12. IV. 1951             | 53                                 | 58                     | 3                                                 | 6               | 23                                     | 7                      | 27. VI. 1951 (b)      | 13 (g)                                    | 13                     | 0                      | 3               |
| O .... | 9. XI. 1950              | 56                                 | 50                     | 4                                                 | 5               | 54                                     | 0                      | 1. III. 1951 (c)      | 35 (h)                                    | 20                     | 1                      | 5               |

(a) The cessation of laying fertile eggs marked the beginning of the sterile period.  
 (b) Male and female cohabit in the second period.  
 (c) Male was removed soon after copulation had ended.  
 (d) Female stopped laying fertile eggs on 10th July and died on 21st July 1951.  
 (e) Female stopped laying fertile eggs on 22nd July and died on 28th July 1951.  
 (f) Female stopped laying fertile eggs on 28th July and since then she underwent a sterile period till she died on 16th September 1951.  
 (g) Female laid no eggs from 10th to 28th July 1951 and so it was dissected.  
 (h) Female stopped laying fertile eggs on 5th April 1951. She laid sterile eggs afterwards and was dissected.

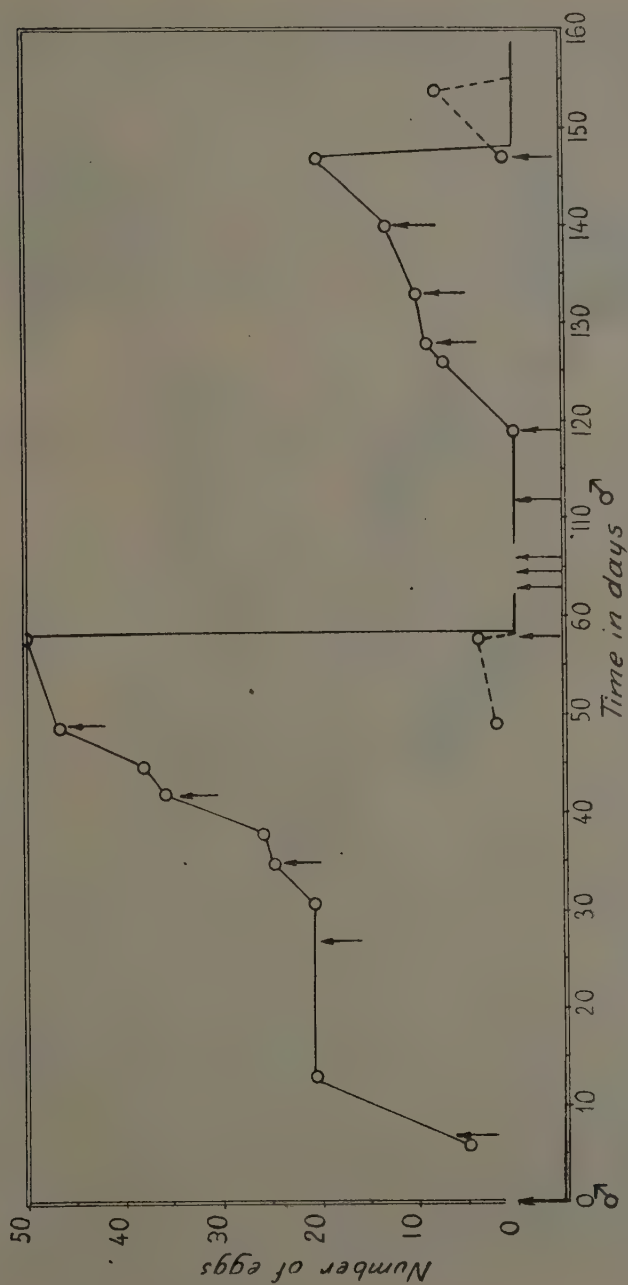


Fig. 2 : The egg-laying behaviour of female *O* (see Table V). Unbroken lines represent the fertile eggs, broken lines represent the sterile eggs. The arrows indicate the time of feeding, and male marks indicate the time of copulation.

deferens there was on each side a round body which was termed by Imms 1934 (after Patton and Cragg) the accessory lobe of testis (Fig. 3). These lobes were found to contain very fine granular secretion and on one occasion only they contained sperm. Several of such structures but smaller in size

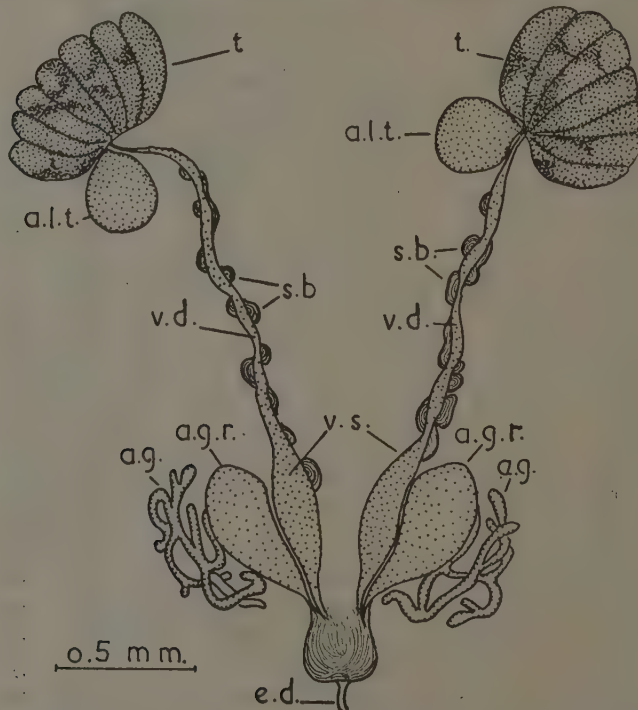


Fig. 3 : The reproductive system of a sterile male (a.g., accessory gland; a.g.r., accessory gland reservoir; a.l.t., accessory lobe of testis; e.d., ejaculatory duct; s.b., swollen bodies; t., testis; v.d., vas deferens; v.s., vesicula seminalis).

were also found along the vasa deferentia which together with the vesiculae seminales were found to contain no sperm but a fine granular secretion; the sperm have disintegrated and disappeared. The accessory glands were normal but their reservoirs were much distended with a transparent secretion. The body cavity, too, was found to contain much of a reserve of fat. Such a male will certainly be unable to fertilize the female and so the production of fertile eggs will not be renewed.

The way in which the sperm have disintegrated in such males is not clear. It was not the result of a failure in the process of spermatogenesis or

the congregation of sperm in the vesiculae seminales, because it was found that males might become sterile after maintaining their fertility for a certain length of time. This was shown when males and females were kept continuously together; some females kept their fertility throughout their lives, but others showed a period of sterility after being fertile for some time. The details of this experiment will be given latter, but the behaviour of one pair of insects will be mentioned here.

Female DD and male No. 11 (see Table VI) reached maturity on 14.xii.1950. On 17.xii., they were fed and put together in a tube and a blood-meal was offered weekly. From that date till 6.i.51, this was a period

TABLE VI  
*Egg production when males and females  
were kept continuously together  
and blood-meals were offered once a week*

| PAIR           | DATE<br>PUT<br>TOGETHER | DATE<br>WHEN<br>OBSERVATION<br>ENDED | TIME<br>FEMALE<br>LIVED<br>IN DAYS | NUMBER<br>OF<br>FERTILE<br>EGGS | NUMBER<br>OF<br>STERILE<br>EGGS | NUMBER<br>OF FEEDS |      |
|----------------|-------------------------|--------------------------------------|------------------------------------|---------------------------------|---------------------------------|--------------------|------|
|                |                         |                                      |                                    |                                 |                                 | FEMALE             | MALE |
| C C + ♂ ....   | 7.XII.1950              | 6.VI .1951 (a)                       | 181                                | 159                             | 5                               | 19                 | 15   |
| D D + ♂ (h) .. | 14.XII.1950             | 5.IV .1951 (b)                       | 112                                | 24                              | 22                              | 7                  | 10   |
| MM + ♂ ....    | 28. II.1951             | 27.IV .1951 (c)                      | 119                                | 153                             | 35                              | 16                 | 11   |
| NN + ♂ ....    | 28. II.1951             | 21.VIII.1951 (d)                     | 174                                | 166                             | 31                              | 24                 | 23   |
| O O ♂ ....     | 28. II.1951             | 16.IX .1951 (e)                      | 200                                | 140                             | 17                              | 22                 | 18   |
| P P + ♂ ....   | 28. II.1951             | 20.VIII.1951 (f)                     | 173                                | 205                             | 3                               | 24                 | 21   |
| MEAN (g).....  |                         |                                      | 182                                | 167.5                           | 14                              | 22.2               | 19.2 |

(a) Female died on 6th June, but male outlived.

(b) Female dissected because the production of fertile eggs has ceased on 14th February, and she started laying sterile eggs.

(c) Female dissected because male died on 23rd May, she stopped laying fertile eggs on 30th May, and then the production of sterile eggs was increased.

(d) Female died on 21st August, but male outlived.

(e) Female died on 16th September, and male on 20th August. The production of fertile eggs ceased on 27th June, and the sterile eggs increased.

(f) Female died on 20th August, male outlived.

(g) The data of DD + ♂ and MM + ♂ were not included in the mean because the male was sterile in the former and died earlier in the latter.

(h) This was male No. 11 mentioned on this page.

of 20 days, she laid 22 fertile eggs; one egg was laid on 25.i., and another on 14.ii., when a clear sterile period appeared. On 5.iv. the female was dissected, the ovaries were found to contain no eggs and the spermathecae no sperm. Then, the male was used to break the sterile period of one of those 10 females mentioned above, but the female maintained her sterility for



more than four months when she was disregarded and male dissected. The male was found to be sterile, the accessory lobes of testes contained a fine granular secretion and the vesiculae seminales no sperm. This experiment will show that males may become sterile after maintaining their fertility for a certain period of time, the sperm must have disintegrated within the vesiculae seminales after being formed and stored in a normal way. This is, perhaps, the effect of the temperature (28-31° C.) at which the insects were kept. It is known, for instance (Raichoudhury 1936) that when pupating larvae or pupae of *Ephestia kuhniella* are kept at temperatures above 27° C., the moths are largely infertile; this is due to an effect on the male; spermatogenesis is retarded and the sperm lose their motility and may disappear.

#### VI. EGG-LAYING BEHAVIOUR OF BUGS FED AT DIFFERENT INTERVALS WHEN MALES AND FEMALES WERE KEPT CONTINUOUSLY TOGETHER

In nature, bugs will feed at intervals depending upon the amount of activity and other environment conditions : temperature, humidity and light. In fact, there is no accurate information about the frequency of feeding and mating in a natural infestation. But in the literature there is sufficient data which indicate that wild bugs feed at intervals of considerably less than 10 days. With regard to mating it was found that some wild females brought from infested houses produced sterile eggs; a fact which indicates that mating may not be frequently performed under natural conditions. But it has been realized throughout this work that if bugs were well fed copulation was to occur suddenly in the majority of cases whenever sexes encountered. So in a heavy infestation it is most likely that females will be kept fertile throughout most of their lives. In the laboratory bugs can be given an opportunity to feed at any regular interval. Moreover, it is possible to induce bugs to feed twice a week or even more under our very warm summer conditions.

It was stated by Johnson (1942) that if the females and males are kept together for 24 hours, so as to allow the females to become mated, the males are then removed, and the females fed regularly, the proportion of sterile eggs increases and at the same time fewer fertile eggs are laid than if the sexes were kept continuously together. The following experiment will show that the general level of egg production and the shortening or eliminating the latent period is totally dependent on the frequency of feeding.

In this experiment 14 pairs of insects were kept continuously together, six were kept until females died, and these were CC + ♂, DD + ♂ (2),

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(2) This was male No. 11 which was mentioned in page 17.

MM + ♂, NN + ♂, OO + ♂, and PP + ♂. They were offered a blood-meal once a week and so the total number of eggs a female can lay under such conditions can be determined. Four other pairs were fed once every

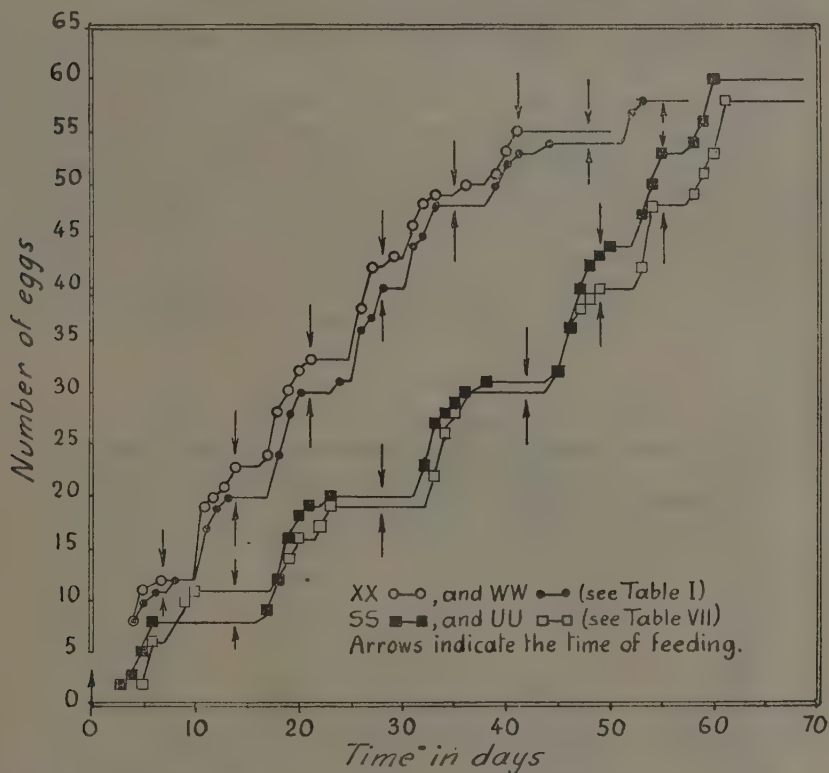


Fig. 4 : The egg-laying behaviour of females fed at different intervals (only the fertile eggs are represented).

fortnight for a period of 7 weeks and then fed at 7-day intervals; these were SS + ♂, TT + ♂, UU + ♂, and VV + ♂; only the last two pairs were kept at room temperature. The last group comprised 4 pairs of insects; they were fed twice a week, and these were G + ♂, I + ♂, J + ♂ and K + ♂.

The quantitative data of the first group of insects are set out in Table VI from which the following conclusions can be drawn : (1) if the average full complement of eggs numbers 181.5 <sup>(3)</sup>, and the female is to be fed on

<sup>(3)</sup> This average was obtained from the amounts of fertile and sterile eggs laid by CC, NN, OO and PP.



ferent batches of eggs were found to extend over several days, 6-11 days. Whereas when bugs were fed at 7-day intervals this period was shortened, 2-3 days. The increase of the general level of egg production of females fed

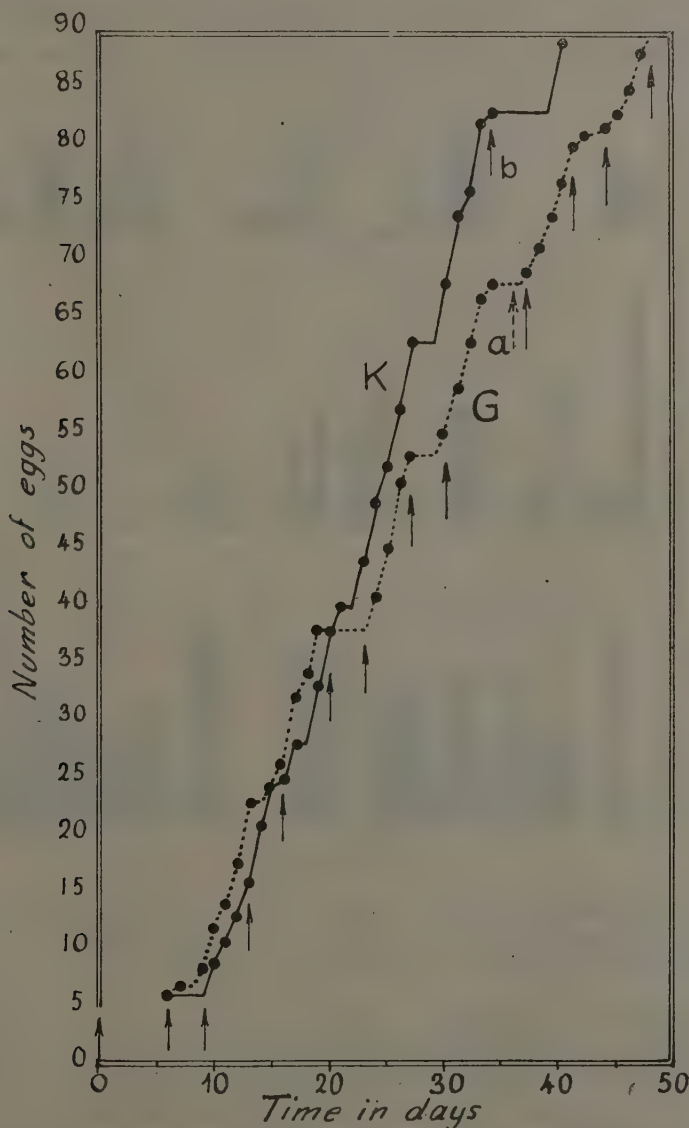


Fig. 5 : The egg-laying behaviour of females fed twice a week, female G and K. Arrows indicate the time of feeding which is common for both females except at point (a) and (b).

at 7-day intervals is quite clear when the egg-laying behaviour of female XX and WW is considered (Fig. 4). It is worth noting that these females were impregnated by starving males which were removed soon after copulation had ended. Moreover, it seems that the production of eggs per meal

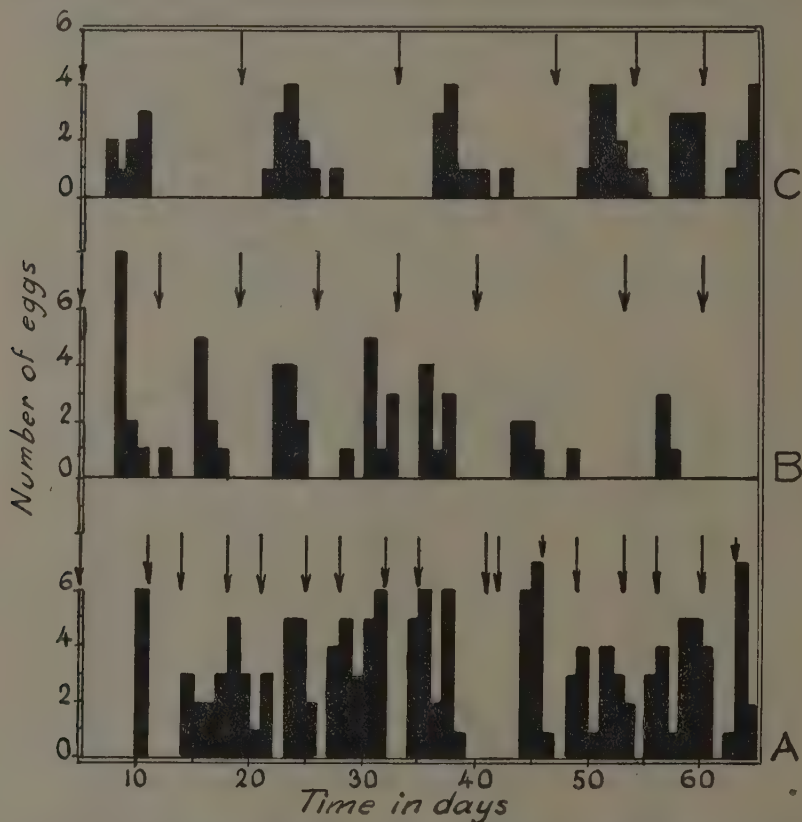


Fig. 6 : Egg production of females fed at varying intervals (A), female K, fed twice a week (see Fig. 5); (B) female WW, fed once a week (see Fig. 4); (C), female SS, fed at 14-day intervals and later at 7-day intervals (see Fig. 4). Arrows indicate when fed.

of females fed once a fortnight is slightly higher than when fed at 7-day intervals; in the former the mean egg number per meal was 10.1 and in the latter 9 (Table VII). This is perhaps due to the bigger size of meal a female will take when fed at 14-day intervals, assuming that all bugs used were of the same size; Johnson (1942) considers that larger females take larger meals. However, the net result of increased frequency of feeding in



a given period is to raise the general level of egg-production as the intervening sterile periods will be shortened. This is shown more clearly in the last group of insects which were fed twice a week. The intervening sterile

TABLE VIII

*Number of fertile eggs  
produced by females fed at different intervals  
during the first six weeks of their adult lives*

| FEMALE  | NUMBER<br>OF<br>FEEDS | NUMBER<br>OF<br>FERTILE<br>EGGS | MEAN |
|---------|-----------------------|---------------------------------|------|
| SS..... | 3                     | 31                              | 30.5 |
| UU..... | 3                     | 30                              |      |
| WW....  | 6                     | 53                              | 54   |
| XX..... | 6                     | 55                              |      |
| G.....  | 12                    | 81                              | 89   |
| K.....  | 12                    | 97                              |      |

periods (Figs. 5 and 6) were sometimes eliminated but occurred some other times irregularly between the different batches of eggs; they were fewer in number and generally shorter than those occurring in the previous cases.

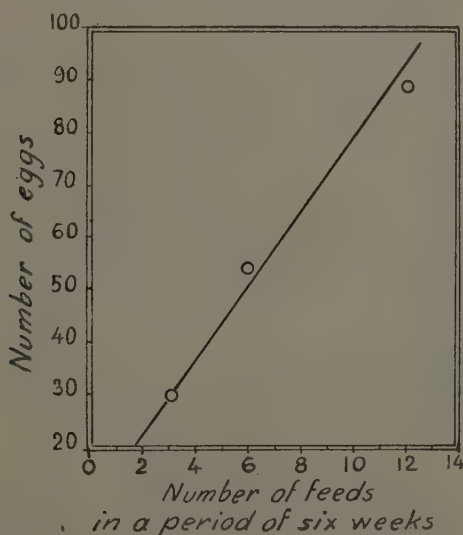


Fig. 7 : The correlation between the number of feeds and the production of fertile eggs (see Table VIII).

The egg-laying behaviour of G + ♂ and K + ♂ is represented by very steep curves (Fig. 5); the other two pairs were quite similar.

Thus, it can be concluded that in fertile females the number of viable eggs produced is totally dependent on the frequency of feeding, the more a fertile female will feed the more is her production of viable eggs. This positive correlation is indicated in Table VIII and Fig. 7.

## VII. SUMMARY

(1) A virgin female bed-bug must be fed and fertilized in order to stimulate ovarian development and so eggs can be produced. When impregnated once a female can remain fertile and produce viable eggs for 50.3 days during which time the mean number of fertile eggs is 46.4.

(2) There is no evidence in that the fertility of males is affected by nutrition. Females mated with starving males produce on the average the same number of eggs and maintained their fertility over the same length of time as those mated with fed males.

(3) Other than the consumption and the disappearance of fats in the starving males starvation has no effect on the different parts of the reproductive system. In *Rhodnius prolixus*, however, starvation has a serious effect on the male accessory glands (Khalifa 1950).

(4) In fertile females the duration of the fertile periods is in direct proportion with the number of blood-meals taken; the greater the number of feeds the longer is the fertile period.

(5) The direct relationship between feeding and egg production is shown quite clearly in two cases: (a) in females known to have impregnated once only; (b) in females kept continuously with males. It is concluded that in fertile females the number of eggs produced is positively correlated with the frequency of feeding. The intervening sterile periods occurring between the different batches of eggs when feeding at 14-day or 7-day intervals are eliminated when feeding occurred twice a week.

(6) When males become sterile, perhaps as result of keeping at a high temperature, their reproductive systems undergo several changes whereby sperm disintegrate and disappear from the vesiculae seminales and testes. In such males and also in sterile females the reserve of fat is very much developed.

## VIII. REFERENCES

- Abraham, R. (1934): Das Verhalten der Spermien der Weiblichen Bettwanze (*C. lectularius* L.) und der Verbleib der überschüssigen Spermasse (Z. Parasitenkunde, VI, 559-591).

- Beament, J.W.L. (1946) : The water proofing process in eggs of *Rhodnius prolixus* Stål (*Proc. Roy. Soc., B*, CXXXIII, 407-417).
- Buxton, P.A. (1930) : The biology of a blood-sucking bug, *Rhodnius prolixus* Stål (*Trans. ent. Soc. Lond.*, LXXVIII, 227-236).
- Cragg, F.W. (1915) : A preliminary note on fertilization in *Cimex* (*Ind. J. med. Res.*, II, 698-705).
- Cragg, F.W. (1921) : Further observation on the reproductive system of *Cimex*, with special reference to the behaviour of the spermatozoa (*Ind. J. med. Res.*, VIII, 32-79).
- Cragg, F.W. (1923) : Observations on the bionimics of the bed-bug, *Cimex lectularius* L., with special reference to the relations of the sexes (*Ind. J. med. Res.*, XI, 449-473).
- Hase, A. (1930) : Weitere Versuche Zur Kenntnis der Bettwanzen, *C. lectularius* L. und *C. rotundatus* Sign. (*Z. Parasitenkunde*, II, 368-418).
- Imms, A.D. (1934) : A general text-book of Entomology.
- Johnson, C.G. (1937) : The relative values of man, mouse, and domestic fowl as experimental hosts for the bed-bug, *Cimex lectularius* L. (*Proc. Zool. Soc. Lond.*, Ser. A, 107-127).
- Johnson, C.G. (1939) : Taxonomic characters, variability, and relative growth in *Cimex lectularius* L. and *C. columbarius* Jenyns [Heteroptera, Cimicidae] (*Trans. R. ent. Soc. Lond.*, LXXXIX, 543-568).
- Johnson, C.G. (1942) : The ecology of the bed-bug, *Cimex lectularius* L., in Britain (*The Journal of Hygiene*, XLI, 345-461).
- Jones, R.M. (1930) : Some effects of temperature and humidity as factors in the biology of the bed-bug, *Cimex lectularius* L. (*Ann. ent. Soc. Amer.*, XXIII, 105-119).
- Jordan, K. (1922) : Notes on the distribution of the organ of Berlese in Clinocoridae (*Ectoparasites*, I, 284-286).
- Khalifa, A. (1950) : Spermatophore production and egg-laying behaviour in *Rhodnius prolixus* Stål [Hemiptera : Reduviidae] (*Parasitology*, XL, 283-289).
- Meillon, B.D., and Hardy, F. (1951) : Fate of *Cimex lectularius* on adult and on baby mice (*Nature*, CLXVII, 151-152).
- Mellanby, K. (1935) : A comparison of the physiology of the two species of bed-bug which attack man (*Parasitology*, XXVII, 111-122).
- Mellanby, K. (1939a) : Fertilization and egg production in the bed-bug, *C. lectularius* L. (*Parasitology*, XXXI, 193-199).
- Mellanby, K. (1939b) : The physiology and activity of the bed-bug, *Cimex lectularius* L., in a natural infestation (*Parasitology*, XXXI, 200-211).

- Raichoudhury, D.P. (1936) : Retardation of spermatogenesis and reduction of motility of sperm in *Ephestia kühniella* Z. caused by high temperature (*Proc. Zool. Soc. Lond.*, 789-805).
- Rivnay, E. (1930) : Technique in artificial feeding of the bed-bug, *C. lectularius* L. (*Journal of Parasitology*, XVI, 246-249).
- Rivnay, E. (1930) : Host selection and cannibalism in the bed-bug *C. lectularius* L. (*Ann. ent. Soc. Amer.*, XXIII, 758-764).
- Rivnay, E. (1932) : Studies in tropisms of the bed-bug, *C. lectularius* (*Parasitology*, XXIV, 121-136).
- Rivnay, E. (1932) : The influence of relative humidity upon the rate of development of the bed-bug, *C. lectularius* L. (*Bull. Soc. Roy. ent. Egypte*, XVI, 13-16).
- Rothschild, L. (1947) : The problem of fertilization (*British Medical Journal*, II, 239).
- Wigglesworth, V.B. (1936) : The function of the corpus allatum in the growth and reproduction of *Rhodnius prolixus* [Hemiptera] (*Quart. J. Micr. Sci.*, LXXIX, 91-121).
- Wigglesworth, V.B. (1950) : The principles of insect physiology.
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BULLETIN  
DE LA  
SOCIÉTÉ FOUAD I<sup>er</sup> D'ENTOMOLOGIE



TABLES DES MATIÈRES  
D U  
TRENTÉ-SIXIÈME VOLUME  
1952





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السنة الخامسة والاربعون

العدد السادس والثلاثون /

# مجلة جمعية فناء الدلالة لعلم الحشرات

سابقا :

جمعية الحشرات المصرية (١٩٠٧ - ١٩٢١)  
والجمعية الملكية المصرية لعلم الحشرات (١٩٢٢ - ١٩٣٧)



تأسست في أول اغسطس سنة ١٩٠٧

وضعت تحت رعاية الحكومة المصرية بمرسوم ملكي  
في ١٥ مايو سنة ١٩٢٣

القاهرة  
مطبعة بول باربييه

١٩٥٢